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Electrical World

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Watch for Next Issue

SO MANY of our readers have expressed an interest in construction, erection and installation methods which save time, labor and material or improve reliability of service that we are devoting about 50 pages of the Sept. 29 issue exclusively to this subject. That issue will contain more than one hundred articles telling of ideas that have worked out successfully in practice.

Illustrations have been used almost entirely to present the ideas. But, in addition, important steps in the processes will be listed and benefits made clear where they are not obvious. This method of presentation is graphic and time-saving.

All engineering and operating department heads as well as executives realize that labor constitutes a very large part of construction expense and that economies should be sought. The ideas presented can be applied directly or modified to suit local conditions.

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A NOTABLE example of the will to achieve unqualified perfection, which is the motive underlying Weston's constant efforts to improve the instrument art, is the company's adoption and first commercial use of bakelite.

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Electrical World

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Increased Business Activity

THE statement of Secretary Mellon on the business outlook served to accentuate the generally satisfactory condition of American industry. Evidence in abundance supports the conclusion that business as a whole is prosperous. The ELECTRICAL WORLD has shown that consumption of electricity by manufacturing plants in major industries was 7.6 per cent higher in August than in the corresponding month last year. Electric utility earnings for the first seven months of the year exceeded by $76,000,000 last year's earnings, and the gross for the year will overtop the best previous year by a still greater ratio. Of course, this is but a reflection of general business conditions; but on top of this comes the September crop report of the Agricultural Bureau indicating a harvest of unusual promise, which means better railroad traffic and incidental benefits in other directions.

Automobile production is attaining record proportions, and since every automobile is equipped with considerable electrical apparatus, growth here should leave an impression on electrical manufacture. Building construction, which also has a direct bearing on the electrical industry, is at present 8 per cent ahead of last year, and the steel trade, generally regarded as a business barometer, shows encouraging activity. Thus, while the country cannot be said to be in for a boom period, there appears to be no reason why the present business activity should not continue and even spread. Indeed, a cursory examination of the major factors should inspire confidence in the general business situation.

* * * *

Specialists for Hard Selling Jobs

LARGE holding organizations usually have a staff of engineering specialists to look after the major engineering aspects of subsidiary properties. These men are experts on expenditures and operations. But very few specialist staffs are found at headquarters whose duties are to get new business. A historical background exists for one staff of specialists but not for the other.

Under present conditions it is well to consider the development of headquarters selling specialists. Business is more difficult to get than it used to be, and new business possibilities lie in directions out of the beaten tracks of commercial experience. It takes more than a sales-manager executive to convince those in control of a production job of the advantages of electric heat. It requires specialists in the several lines to start and operate the pioneering sales programs dealing with such equipment as ranges, refrigerators, water heaters and even radio sets. To sell municipalities wholesale energy or to take over large and efficient private plants in industries requires salesmen with the proper commercial and technical qualifications.

Individual subsidiary properties cannot keep specialized new-business talent busy, but each property has prospects where the services of specialists can be used. Each property needs specialized surveys of territorial resources and new-business possibilities. The time appears opportune to add specialized new-business staffs to the management forces of large utility organizations. Ample new business is available, but it must be obtained by competent men.

* * * *

State-Wide Uniformity of Rate Structures

CONSIDERATION has been given for a long time to the desirability of state-wide schedules having similar form, but John S. Wise, Jr., had the courage of his convictions when he advocated such a change publicly in his presidential address before the Pennsylvania Electric Association recently. He is to be commended for his farsightedness and boldness, considering the variety of rate forms in existence and the difficulty of supplanting them with a single rate structure for each major class of service.

The need for such simplification has been particularly emphasized since the advent of extensive interconnection and rural service. No one who is fully acquainted with the economics of electric service is advocating that the price charged for a certain amount of energy shall be the same throughout a state, because conditions differ greatly. However, the difference in rate structures sometimes makes it appear that there is discrimination when actually the unit charge for the same amount of energy under similar conditions is virtually identical. When urban or farm customers in adjoining territories *think* they are being charged different amounts for the same service, there is always chance of public dissatisfaction; and when this condition exists on interconnected systems or in subsidiaries of the same company, it is even more difficult to explain differences.

With equity and simplicity working at cross-purposes in the formulation of rate structures, and with so many opinions on what constitutes a desirable rate, outstanding leadership will have to be exercised if state-wide rates of similar form are to be established. But the benefits are worth the effort and should justify compromises to establish uniformity of rate structures. That the job can be accomplished is indicated by the striking similarity of rural rate structures in many parts of the country. The trend toward the inducement form of domestic rates, even though actual figures differ, also shows striking similarity in form. Even among companies which have acquired several new properties with

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totally different rate structures, uniformity of rate structures has been established in some cases.

While this problem is being considered the consolidation of power rates into a few simple forms should not be overlooked. Some persons claim there are too many variables to allow consolidation, but the Duquesne Light Company is one organization that has recently made the first step toward such simplification. Greater uniformity in rate structures will increasingly be demanded, and individual companies and state groups of companies will have to consider separately and collectively how best to reduce the variety that has prevailed.

* * * *

Beauty in Power Lines

ENGLAND is all agog over the esthetic considerations involved in the extension of transmission lines throughout Great Britain. Our respected contemporary *The Electrician* reports that the menace has been viewed as "playing havoc with what little of the English landscape there is as yet undefaced by petrol filling stations and bungaloid and other growths of recent origin." It has been pointed out, in a lighter moment, that it "may be possible to design transmission towers on the lines adopted for the imitation trees used as observation posts in the last war, or to evolve a tower constructed of half-timber and brick nogging with a special treillage for ivy," but that the ensuing mirth would be most evident. There is, however, a real movement under way, the necessity for transmission lines being granted, to insure the best possible visual effects in connection with such structures.

Much may, indeed, be done along this line with profit to the amenities and the betterment of the feeling between the utility and the community. A recent metropolitan development in this country has brought not one but several tower lines paralleling each other for miles and rendering hideous, by an unforgivable iron and brick structure, the land directly opposite a fine country club. Engineering brains are sometimes unassociable with what a disinterested party might justifiably call "good sense." Transmission towers can be made inherently graceful and pleasing to the eye and many qualify in these respects, but through sheer incongruity of location they sometimes become a burden and highly distasteful.

* * * *

Progress of Radio Brings New Problems in Sales Policy

IT IS estimated that at the present time there are about eight million homes equipped with radio, eight years after the inauguration of the first broadcasting station. It is interesting to consider that it was thirty-seven years after the first Edison central station began to provide electric service to the public before as many homes as this were using electric light. And it was forty-two years after Bell perfected his invention before this number of houses were equipped with telephones. This, of course, does not indicate the comparative value of these services. It does not necessarily mean that radio will ultimately be in more universal use than either the telephone or the common household applications of electricity. But it does testify to the tremendous popular appeal of this new service of music, news and entertainment and to the speed with which such an idea sweeps the country in this day of rapidly advancing thought.

Of these eight million radio sets now in operation, in the neighborhood of three-quarters of a million are operating on alternating current taken from the lines of power companies. Probably two million are using other forms of energy supply connected to central-station circuits. With the steadily increasing popularity of the alternating-current set, therefore, the importance of radio as a source of domestic load becomes more and more apparent and impressive. For such a set will increase the consumption of energy in the average home by virtually one-third. In the building of the modern residence load, then, and in the relationship between the power company and the public, radio is fast becoming a major interest, and it is going to require very careful study by the sales executives of these utilities. The present trend toward the combination of radio and the phonograph in a single cabinet is bringing a new relationship between the power companies and the music trade. How far should the utility go in merchandising the expensive furniture which is now becoming a feature of this line?

* * * *

Switching and Style

WHEN a new type or arrangement of equipment receives extensive application it is frequently remarked that a desire for novelty is affecting engineers or that they are subscribing to a fad. But back of most of these so-called styles or fads are sound technical or economical reasons for their popularity—reasons which the cautious are willing to accept after the courageous have done the pioneering.

The trend toward metal-inclosed switchgear is an example. Although American power-house operators prefer to have all electrical apparatus easily accessible and are uneasy about concealed parts of circuits, a chance was taken in industrial plants at concealing switchgear parts in metal inclosures to protect persons unfamiliar with equipment from accidental contact. Once the ease of installation, replacement, interchangeability, and so forth, became recognized, the use of such equipment spread even into power houses, first for auxiliary work, then for main equipment and now for outdoor switching.

The metal-clad ideas, including the term "switchgear," came over from Europe and have been undergoing a process of Americanization. This development runs quite parallel to that in American architecture and decorative art. The switchgear is being developed along vertical lines, quite consistent with the so-called "skyscraper line." The breaker moves vertically, and extensions for meters and other accessories are built above the breakers. Steel is used throughout instead of castings. In Europe the corresponding equipment is built along horizontal lines.

It will be interesting to watch the progress of the development of a thoroughly Americanized type of steel-clad switching equipment, and then perhaps the term "switchgear" will be replaced by a more practical American term. In this process of development it is to be hoped that steel will eventually replace cast iron, that the units will continue to be extended vertically rather than horizontally to conserve valuable space, that instruments and accessories will not be added as an afterthought, that secondary wiring will be systematically arranged, that potential and current transformers, as well as switch contacts, will be made readily accessible for replacement, that potheads will be made adaptable to conduit connection, and that semaphores will be plainly visible.

More Powerful Cathode Rays

REMARKABLE and rapid advances in synthetic chemistry are promised through the use of high-speed electronic bombardment, which is made available by the Coolidge cathode-ray tube. High-speed electron bombardment provides a new and powerful instrument for upsetting the stability of many types of molecule and atom, transforming them to other types of stable compound, thus providing a rapid and efficient process for replacing old and expensive methods, and in many cases offering a means for transformation hitherto unknown or thought to be impossible. High-velocity cathode rays have long been available within the confines of the vacuum tube, but these conditions do not lend themselves readily to the chemical transformations referred to.

The Coolidge high-voltage tube provides a means for bringing the cathode rays through a window into the open, where different materials may be readily subjected to their influence. Announcement now comes from Germany that Prof. H. Plauson has effected such improvements in the Coolidge tube as to make possible a very great intensification of ionic activity. The improvements consist of the use of the metal beryllium instead of nickel for the window in the tube and of a rotating magnetic field for controlling the electron stream. The new tube is said to convert quickly the waste products of petroleum stills and coke ovens into rubber, alcohol, acetic acid and valuable drugs and perfumes. It is also stated that moist air is converted directly into nitric acid, that synthetic rubber may be made with astonishing rapidity, and that with cold water and air as raw materials it is possible to make alcohol, methanol, acetic acid, ether and other such products. In fact, the claims that are made for this new agent are so remarkable that, if they are substantiated, it would appear that an entirely new era in synthetic chemistry is opening. It is to be hoped that these claims, which appear at present almost extravagant, will be duly substantiated by repetition and scientific report. Accounts of such further studies will be awaited with the keenest interest.

* * * *

Service Interruptions from Lightning

ONE company that for a number of years has been giving considerable attention to lightning protection of distribution circuits recently made an investigation with the assistance of the engineers of several of the larger manufacturers of lightning arresters and reached the conclusion that about two-thirds of the service interruptions on this system occurring during lightning storms were due to preventable causes.

At least half of the transformers which were removed from the line and sent in to the shops for repairs still had the coils in condition for service. The troubles were confined to the primary and secondary leads and bushings and to the connections between coils inside of the case. In some instances the primary leads were in contact with the inside of the case. In other instances there was very scant clearance between the primary or secondary leads and the case, or from the connections between the primary coils to the frame supporting the core.

Other causes of troubles were bushings that were too small or defective or had been cracked during assembly in the factory or handling in the field. Apparently some transformers are still designed with such small clearances to case that they will serve as their own lightning arresters. The investigation indicates that the transformer manufacturers should pay just as much attention to the connections between coils and the design of the supports of the connections to these windings and to the design and installation of the porcelain bushings as they do to the design and details of manufacture of the primary and secondary coils.

The investigation also indictated the need for more thorough inspection and careful maintenance of line transformers for distribution voltages than some companies have heretofore considered necessary. Perhaps other companies, by making a similar detailed and careful examination of the effects of lightning on transformers which have been damaged and taken out of service in their own system on account of lightning storms, can discover how to improve their service to their customers.

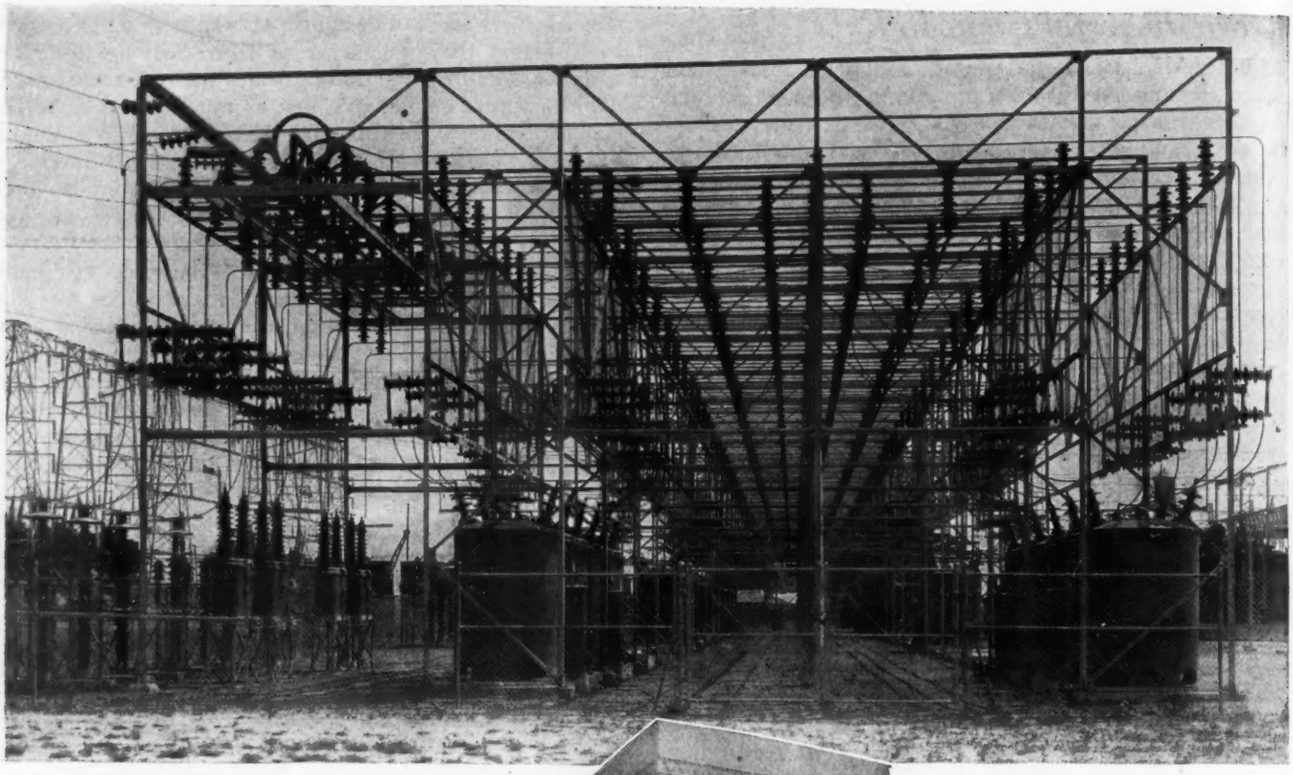
* * * *

New England Advances

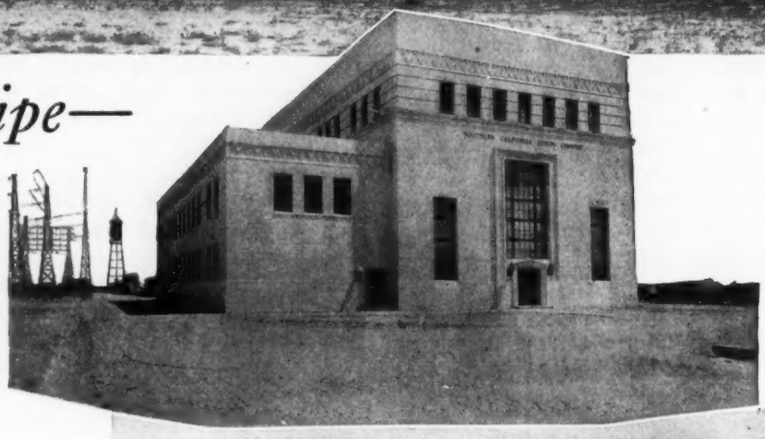
PRESENT engineering activity in the New England utility field presages gratifying commercial and industrial progress in the Northeast. Important steps are being taken to develop new and larger markets; manufacturing is becoming more diversified and efficient, and a striking program of hydro-electric expansion is being launched. The region is passing through a transition period with regard to the textile and leather industries and their relation to future economic progress in old or new sites, but substantial gains are being recorded in many lines, and these are aided not a little by the expansion of power producing and distributing facilities.

About a hundred New England central-station companies are active in co-operative industrial development work, helping to stabilize industry and to bring new enterprises into this field. Their reward in good public relations is second only to the resulting increase in energy sales, which in turn tends to reduce unit costs and to lower the price of service. Interest in factory betterment work is reflected in a surprisingly steady and large volume of weekly motor sales, coupled with considerable activity in industrial heating and lighting.

Major hydro-electric projects totaling around fifty million dollars and rated at over one-third of a million horsepower are at the point of "take-off" from the preliminary construction stage. These include the Fifteen-Mile Falls development of the New England Power Association on the upper Connecticut, the initial Bingham development of the Central Maine Power Company on the Kennebec and the comprehensive development of the Rocky River by the Connecticut Light & Power Company. The prospects are that several years will be occupied in these projects, and if the next Maine Legislature modifies the Fernald law sufficiently to permit the exportation of surplus hydro-electric energy to other states, many millions of additional money is expected to be forthcoming for large-scale water-power construction. Far-reaching interconnection plans are in the making to reduce operating costs and lessen capital requirements for generating equipment to serve the regional market. All along the line from the interior hydro power sites to the heart of the urban distribution systems New England's electrical progress is attaining a momentum which is a satisfying index of underlying confidence and prosperity.



Lighthipe—

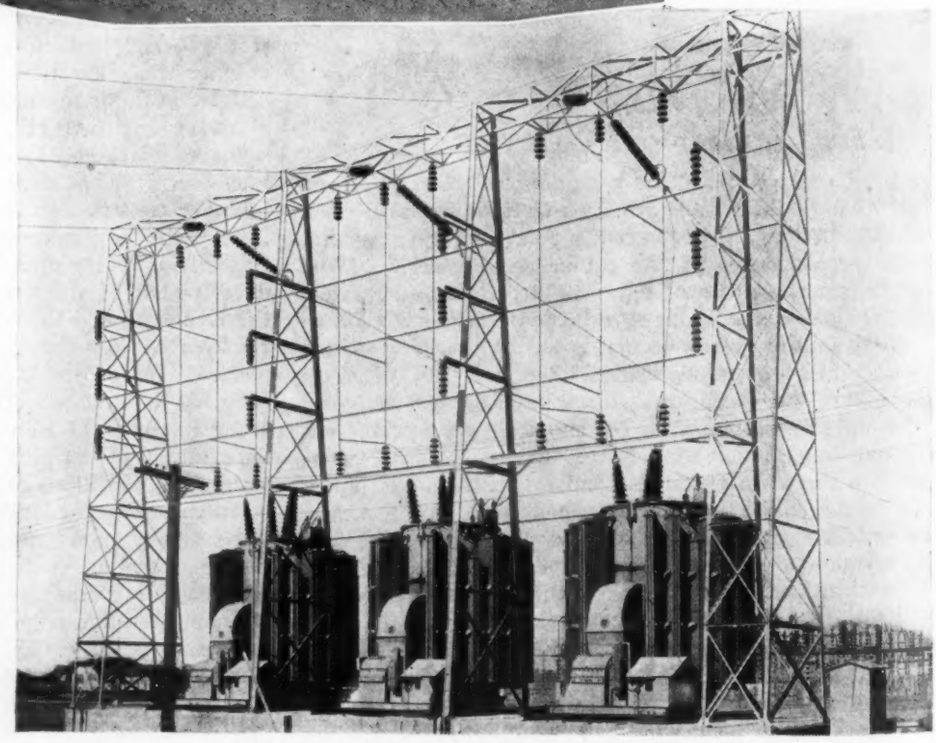


An Up-to-Date Substation

At the top is shown the 66-kv. bus and switch rack, which is divided in three sections and designed to accommodate 22 outgoing feeders. This permits economical circuit breaker sizes.

The attractive building at Lighthipe contains two 50,000-kva. synchronous condensers with switchboards and control apparatus.

The lower view shows the 75,000-kva., 220/66-kv. transformer banks of this Southern California Edison Company station, provided with automatically controlled, forced-draft cooling systems.



Effect of Ground Wire

on Traveling Waves

Solidly grounded wire effective in a tower span because voltage of ground wire reduces to zero. Analysis of effect based on pessimistic assumptions

By J. H. Cox and J. Slepian
Westinghouse Electric & Manufacturing Company

THE value of overhead ground wires on a transmission line in reducing the magnitude of surges induced by lightning has been discussed considerably and has been appreciated to a more or less extent. The reduction referred to is that of the capacity effect in reducing the surge at the point of induction. The influence of the ground wire on the surge after it has become a traveling wave has not received appreciable attention. It will be shown that after a wave has passed a tower where the ground wire is solidly grounded, zero resistance, or a few towers where contact resistance is considered, the condition of grounding at subsequent towers is without influence.

Assumptions Made in Analysis

The induction of a surge by a lightning stroke at a point in a continuous line with a ground wire and the progress of the traveling wave thereafter will be discussed. For simplicity, only rectangular waves will be considered. Furthermore, in the examples, it will be assumed that the lightning stroke is instantaneous, so that when the wave arrives at the first tower the voltage on the ground wire is proportional to its height and the cloud field gradient. In practice, waves are not rectangular and the cloud discharge is not instantaneous. Both of these factors alleviate the severity of conditions, so the quantitative figures given are pessimistic. The equations developed give the nature of the reflections regardless of shape, assuming the lengths of wave fronts and distances involved to be such that complete reflections are possible before successive arrival of the wave front.

Let two lines as in Fig. 1A be considered: (1) Will be taken as the line conductor and (2) the ground wire. Assuming a uniform field and an instantaneous cloud discharge, the potentials on the wires due to the bound charges will be:

$$E_1 = Gh_1$$
$$E_2 = Gh_2$$

where E_1 and E_2 are the total voltages, G is the cloud field gradient and h_1 and h_2 are the respective heights of the wires. As is well known, the initial potential on the conductors consists of two parts, or waves, which travel in opposite directions. Let the quantities without primes be associated with the waves traveling to the right and the quantities with primes be associated with the waves traveling to the left. The first subscript will indicate the conductor, the second subscript, *o*, *t* or *r*, will indicate initial, transmitted or reflected quantities respectively. Then the initial voltages will be:

$$Gh_1 = V_{10} + V_{10}'$$
$$Gh_2 = V_{20} + V_{20}'$$

and

$$V_{10} = V_{10}'$$
$$V_{20} = V_{20}'$$

Voltage waves are inseparable from current waves, and

$$i_{10} = -i_{10}'$$
$$i_{20} = -i_{20}'$$

It should be noted here that the potential on the line at the location of the bound charge is twice the potential of each traveling wave.

In this note that only the traveling waves will be considered, and, since the conditions in both directions are identical, only the waves traveling to the right will be discussed. Taking the wave traveling to the right

$$V_{10} = Z_1 i_{10} + z i_{20} \quad (1)$$
$$V_{20} = z i_{10} + Z_2 i_{20} \quad (2)$$

where Z_1 and Z_2 are the surge impedances of the two lines respectively and z is the mutual surge impedance.[1] From equations (1) and (2)

$$i_{10} = \frac{Z_2 V_{10} - z V_{20}}{Z_1 Z_2 - z^2} \quad (3)$$

$$i_{20} = \frac{Z_1 V_{20} - z V_{10}}{Z_1 Z_2 - z^2} \quad (4)$$

Case I—Ground Wire with Perfect Grounds.

The ideal case—that is, with zero resistance conductors and zero grounding resistance at the towers—will first be considered. The conductors with the first ground and the oncoming waves are shown in Fig. 1B. When the wave encounters a point at which the ground wire is grounded a reflection occurs. Let the transmitted quantities be V_{1t}, V_{2t}, i_{1t} and i_{2t}, and the reflected quantities be V_{1r}, V_{2r}, i_{1r} and i_{2r}. Then, as in equations (1) and (2) for the initial wave,

$$V_{1t} = Z_1 i_{2t} + z i_{2t} \quad (5)$$
$$V_{2t} = z i_{1t} + Z_2 i_{2t} \quad (6)$$

Since the reflected wave travels in the reverse direction, the equations for the reflected voltages will be

$$-V_{1r} = Z_1 i_{1r} + z i_{2r} \quad (7)$$
$$-V_{2r} = z i_{1r} + Z_2 i_{2r} \quad (8)$$

The voltage and current on line 1 must be equal on both sides of the discontinuity, so

$$V_{10} + V_{1r} = V_{1t} \quad (9)$$
$$i_{10} + i_{1r} = i_{1t} \quad (10)$$

Also the voltage on line 2 at the grounded point must be zero, so

$$V_{20} + V_{2r} = O \quad (11)$$
$$V_{2t} = O \quad (12)$$

[1] *Reinhold Rudenberg, "Elektrische Schaltvorgange," pages 387 to 396. Julius Springer, Berlin, 1924.*

The eight equations (5) to (12) inclusive yield the following for the voltages and currents at the point of reflection:

$$V_{1t} = V_{10} - \frac{z}{Z_2} V_{20} \tag{13}$$

$$V_{2t} = O \tag{14}$$

$$i_{1t} = \frac{Z_2 V_{10} - z V_{20}}{(Z_1 Z_2 - z^2)} = i_{10} \tag{15}$$

$$i_{2t} = -\frac{z}{Z_2} i_{1t} = -\frac{z}{Z_2} i_{10} \tag{16}$$

$$V_{1r} = -\frac{z}{Z_2} V_{20} \tag{17}$$

$$V_{2r} = -V_{20} \tag{18}$$

$$i_{1r} = O \tag{19}$$

$$i_{2r} = i_{20} + \frac{z}{Z_2} i_{10} \tag{20}$$

Equations (13) to (20) are interesting due to the light they throw on the exact nature of the reflections. However, the nature of the phenomena at the grounded point, or tower, might have been determined by an inspection of the original equations. At a solidly grounded point there can be no voltage, and therefore V_{2t} must be zero. However, there will be an induced current from line (1) in line (2), and equation (6) becomes equation (16). Thus, after the first tower there will be no voltage on the ground wire. The wave will induce a negative current, but the resulting voltage is exactly neutralized by the current in the neighboring line wire. Since the voltage on the ground wire is reduced to zero at the first tower it is obvious that subsequent points of grounding of the ground wire can have no influence on the wave in either conductor. Fig. 1C shows the nature of the waves at the first tower.

Case II—Ground Wire with Resistance in Grounds.

In the practical case of a transmission line with a ground wire there is resistance in the tower and in the footing. This is shown diagrammatically in Fig. 1D. The waves are shown in Fig. 1C. For this case the first six equations for the waves at the reflection point are the same as those for the solidly grounded case; that is, equations (5) to (10) inclusive. The remaining equations are:

$$V_{20} + V_{2r} = V_{2t} \tag{21}$$

$$i_{20} + i_{2r} = i_{2t} + \frac{V_{2t}}{R} \tag{22}$$

These eight equations (5), (6), (7), (8), (9), (10), (21) and (22) when solved yield the following:

$$V_{1t} = V_{10} - \frac{z}{(Z_2 + 2R)} V_{20} \tag{23}$$

$$V_{2t} = \frac{2R}{Z_2 + 2R} V_{20} \tag{24}$$

$$i_{1t} = \frac{Z_2 V_{10} - z V_{20}}{Z_1 Z_2 - z^2} = i_{10} \tag{25}$$

$$i_{2t} = \frac{-z i_{10} + 2R i_{20}}{Z_2 + 2R} \tag{26}$$

$$V_{1r} = -\frac{z}{(Z_2 + 2R)} V_{20} \tag{27}$$

$$V_{2r} = -\left(1 - \frac{2R}{Z_2 + 2R}\right) V_{20} \tag{28}$$

$$i_{1r} = O$$

$$i_{2r} = \frac{z}{Z_2 + 2R} i_{10} + \frac{Z_2}{Z_2 + 2R} i_{20} \tag{29}$$

From equation (24) it is seen that the voltage on conductor (2) is reduced at the tower, and the lower the resistance the greater is the reduction. It is thus obvious that at each tower V_2 is lowered and that, with a reasonably low value of resistance, after a very few towers V_2 will be practically zero. After this succeeding towers can have no further effect unless the ground wire is discontinued.

Case III—Ground Wire and Line Conductors with Resistance Included.

In the above two cases the conductors were considered as of zero resistance. It will be of interest to determine the effect of series resistance. Since any consideration of distributed resistance becomes quite involved an approximate solution will be developed with the assumption that the resistance of the span is concentrated immediately beyond the tower as shown in Fig. 1F. The nature of the wave is shown in Fig. 2A.

The first four equations for the waves at the reflection point in this case are the same as those for Case I, namely, equations (5) to (8) inclusive. The remaining equations are:

$$V_{10} + V_{1r} = V_{1t} + R_1 i_{1t} \tag{30}$$

$$i_{10} + i_{1r} = i_{1t} \tag{31}$$

$$V_{20} + V_{2r} = O \tag{32}$$

$$V_{2t} = -R_2 i_{2t} \tag{33}$$

The eight equations (5) to (8) and (30) to (33) when solved

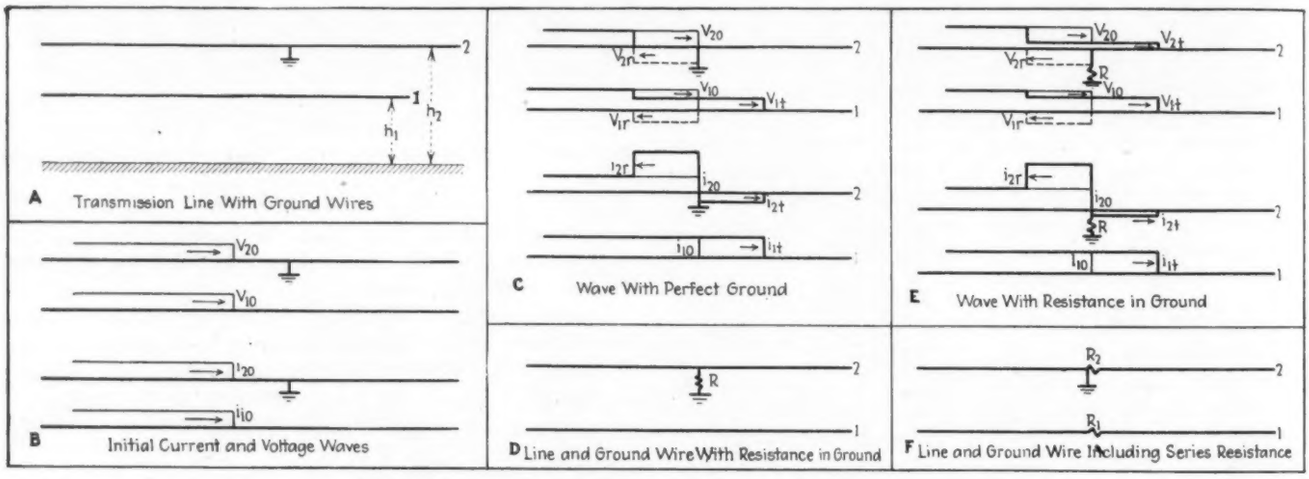

A Transmission Line With Ground Wires
B Initial Current and Voltage Waves
C Wave With Perfect Ground
D Line and Ground Wire With Resistance in Ground
E Wave With Resistance in Ground
F Line and Ground Wire Including Series Resistance

Fig. 1—Traveling wave conditions for various cases

yield the following values for the transmitted voltages and currents.

$$V_{1t} = \frac{2\left(V_{10} - \frac{z}{Z_2} V_{20}\right)}{1 + Z_1 + R_1 - \frac{z^2}{Z_2}} \tag{34}$$

$$V_{2t} = \left(V_{10} - \frac{z}{Z_2} V_{20}\right) \frac{2 z R_2}{Z_1\left(Z_2 + R_2 - \frac{z^2}{Z_1}\right) + (Z_2 + R_2)\left(Z_1 + R_1 - \frac{z^2}{Z_2}\right)} \tag{35}$$

$$i_{1t} = \frac{2 i_{10}}{1 + \frac{Z_1 + R_1 - \frac{z^2}{Z_2 + R_2}}{Z_1 - \frac{z^2}{Z_2}}} \tag{36}$$

$$i_{2t} = -\frac{2 z}{(Z_2 + R_2)} \frac{i_{10}}{1 + \frac{\left(Z_1 + R_1 - \frac{z^2}{Z_2 + R_2}\right)}{Z_1 - \frac{z^2}{Z_2}}} \tag{37}$$

The equations for the reflected waves are not given for the reason that they are even more involved than those for the transmitted waves. In actual calculations, if the magnitudes of the reflected waves are desired, they may be obtained from equations

(30), (31), (32) and (7) by inserting the values derived from equations (34) to (37) inclusive.

In equation (34) the conductor resistances enter only when added to surge impedances. From a comparison of the magnitudes of the conductor resistances and the surge impedances, as found in practice, typical values of which are given below, it is evident that, when a conducting material is used as ground wire, the resistances of the conductors, over distances of the order of a span length, have a negligible effect on the magnitude of the transmitted voltage on the line conductor. Also the voltage remaining on the ground wire due to its own resistance is negligible.

Effect of Attenuation

In a discussion of the effect of series resistance on a traveling wave the attenuation factor should be considered. A wave is attenuated, as it travels along a line, by the losses due to the surge current passing through the resistance of the circuit. The circuit involved, however, is not simply the conductors. Corresponding to the surge current in the conductor there is a similar current of opposite sign in the earth, which flows in the path represented by the image of the conductor and also in any grounded conductors near by. The complete circuit, therefore, includes this return circuit. In comparing the attenuation of a wave on a transmission line provided with ground wires with that on a line not so provided it is necessary to include a consideration of the current in the earth and ground wires. The presence of ground wires reduces the effective surge impedance, which increases the current in the line conductors for a given voltage. This higher current, of course, increases the losses. Furthermore, in the presence of ground wires part of the return current is forced to flow in the ground wires, which, although reducing the surge impedance, has the effect of increasing the virtual resistance of the earth circuit. This still further increases the losses. Although, with a given voltage, the energy of a surge on a line equipped with ground wires is greater than that on a line not equipped with ground wires, the losses are a much greater percentage of this energy, so the attenuation is correspondingly more rapid.

The attenuation factor of a line depends not only upon the resistance of the circuit, but also upon all leakage paths, which include corona when the voltage of the surge is above the corona point. Ground wires, by reducing the spacing of the conductors to the return circuit, increase the corona losses. The percentage increase in this loss, also, is greater than the percentage increase in the surge energy due to ground wires. The result is that, considering both resistance and leakage, the attenuation factor of a line is considerably increased by the presence of ground wires.

Case IV—Reflections Where the Ground Wire Is Disconnected.

Of particular importance are the voltages on a line conductor beyond a point where a ground wire ends. In many cases it has been the practice to end the ground wire at the first tower from a station and bring the conductors into the substation structure without the ground wire. This condition is shown in Fig. 2B. Zero ground resistance will be assumed. The equations for the incoming waves are the same as those previously given; that is, equations (1) to (4). Since, in this case, there are no transmitted waves on the ground wire, there are only six unknown quantities, V_{1r}, V_{2r}, i_{1r}, i_{2r}, V_{1t} and i_{1t}. Five of the necessary

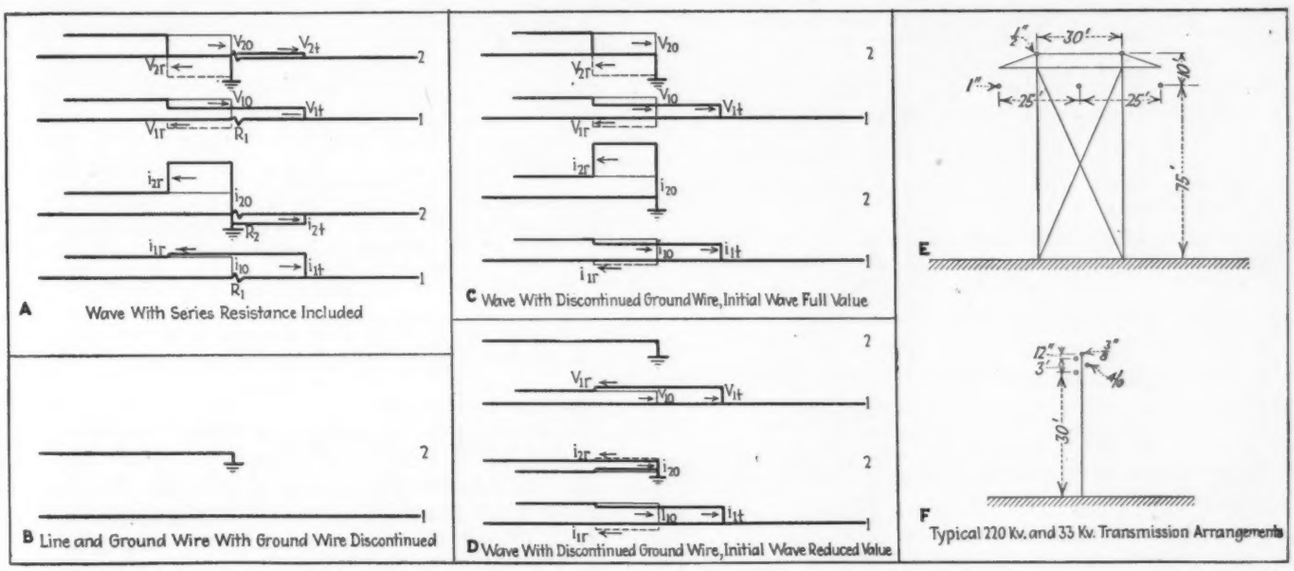

A Wave With Series Resistance Included
B Line and Ground Wire With Ground Wire Discontinued
C Wave With Discontinued Ground Wire, Initial Wave Full Value
D Wave With Discontinued Ground Wire, Initial Wave Reduced Value
E
F Typical 220 Kv. and 33 Kv. Transmission Arrangements

Fig. 2—Attenuation affects conditions involving traveling waves

equations are the same as equations (7) to (11) inclusive. The remaining equation is:

$$V_{1t} = Z_1 i_{1t} \tag{38}$$

These equations yield the following:

$$V_{1t} = \frac{V_{10} - \frac{z}{Z_2} V_{20}}{1 - \frac{z^2}{2Z_1Z_2}} \tag{39}$$

$$i_{1t} = \frac{2(Z_1Z_2 - z^2)}{2Z_1Z_2 - z^2}\, i_{10} \tag{40}$$

$$V_{1r} = \frac{V_{10} - \frac{2Z_1}{z} V_{20}}{\frac{2Z_1Z_2}{z^2} - 1} \tag{41}$$

$$i_{1r} = -\frac{z^2}{2Z_1Z_2 - z^2}\, i_{10} \tag{42}$$

$$V_{2r} = -V_{20}$$

$$i_{2r} = i_{20} + \frac{2Z_1 z}{2Z_1Z_2 - z^2}\, i_{10} \tag{43}$$

The nature of these reflections is shown in Fig. 2C and Fig. 2D for conditions with full voltage on the ground wire, as where the surge originated in the adjacent span, and with zero voltage on the ground wire, as where the surge originated at some distance away, respectively.

Examples of Ground Wire Action

To convey a quantitative idea of the amount the traveling waves are influenced by the various conditions, the foregoing equations will be applied to two typical examples. These

examples will be: (1) A three-phase, horizontally spaced, 220-kv. line with two ground wires and (2) a three-phase, triangularly spaced, 33-kv. line with one ground wire. The configurations of the two lines are shown in Fig. 2E and F.

Considering the three conductors in parallel and the ground wires in parallel, the constants of the 220-kv. line are:

$Z_1 = 226$ ohms
$Z_2 = 323$ ohms
$z = 118$ ohms
r_1 per 1,000 ft. $= 0.0097$ ohms
r_2 per 1,000 ft. (aluminum) $= 0.053$ ohms
r_3 per 1,000 ft. (iron) $= 0.150$ ohms

Considered in the same way, the constants of the 33-kv. line are:

$Z_1 = 285$ ohms
$Z_2 = 502$ ohms
$z = 190$ ohms
r_1 per 500 ft. $= 0.0088$ ohms
$r_2 =$ per 500 ft. (aluminum) $= 0.105$ ohms
r_2 per 500 ft. (iron) $= 0.265$ ohms

Case I—Ground Wire with Perfect Grounds.

It will be assumed that V_{10} and V_{20} are initially in proportion to the respective heights of the conductors (1) and (2) above ground. Assuming zero resistance conductors on the 220-kv. line, the transmitted voltage on the line conductors will be:

$$V_{1t} = \left(1 - \frac{118}{323} \times \frac{85}{75}\right) V_{10} = 0.586 V_{10}$$

On the 33-kv. line the transmitted voltage will be:

$$V_{1t} = \left(1 - \frac{190}{502} \times \frac{34}{31.5}\right) V_{10} = 0.592 V_{10}$$

As pointed out above, in this case there is no further reduction at subsequent towers.

Case II—Ground Wire with Resistance in Grounds.

With the same assumption as above, but with 5 ohms resistance in the ground connection, on the 220-kv. line:

$$V_{1t} = \left(1 - \frac{118}{323 + 10} \times \frac{85}{75}\right) V_{10} = 0.598 V_{10}$$

$$V_{2t} = \frac{10}{323 + 10} V_{20} = 0.030 V_{20}$$

On the 33-kv. line with 5 ohms grounding resistance:

$V_{1t} = 0.599 V_{10}$ $\qquad$ $V_{2t} = 0.019 V_{20}$

All of the above values are nearly the same as those with zero ground resistance. If 50 ohms grounding resistance is assumed on the 220-kv. line:

$V_{1t} = 0.684 V_{10}$ $\qquad$ $V_{2t} = 0.236 V_{20}$

The voltages transmitted at the second tower are:

$V_{1t} = 0.618 V_{10}$ $\qquad$ $V_{2t} = 0.056 V_{20}$

With 50 ohms grounding resistance on the 33-kv. line:

$V_{1t} = 0.659 V_{10}$ $\qquad$ $V_{2t} = 0.166 V_{20}$

At the second tower:

$V_{1t} = 0.607 V_{10}$ $\qquad$ $V_{2t} = 0.027 V_{20}$

It is seen that even with a grounding resistance of 50 ohms per tower, the voltages at the second tower approach those of the perfectly grounded case. Hence, any reasonable value of footing resistance is satisfactory from this viewpoint, and the wave is not influenced after passing the first few towers.

Case III—Ground Wire and Line Conductors with Resistance Included.

Applying equation (35) to the 220-kv. line, with aluminum ground wires, shows that beyond the first tower:

$$V_{2t} = 0.00008 V_{20}$$

This indicates that the effect of conductor resistance, where a conducting material is used, is negligible.

The resistance of a steel wire to a steep front traveling wave is difficult to determine, but it is known to be many times the direct-current resistance. Assuming a value of 100 times the direct-current resistance for the steel ground wire, or 15 ohms per span on the 220-kv. line, the voltages on that line will be, according to equations (34) and (35):

$$V_{1t} = 0.590 V_{10}$$

which is to be compared with $0.586 V_{10}$ for the zero resistance case. And:

$$V_{2t} = 0.010 V_{20}$$

At the second tower there is negligible change.

On the 33-kv. line with a ground wire resistance of 26.5 ohms per span, or 100 times the direct-current resistance, the transmitted voltages will be:

$$V_{1t} = 0.598 V_{10}$$

compared with $0.592 V_{10}$ for the zero resistance case. And:

$$V_{2t} = 0.024 V_{20}$$

These results indicate that, from the standpoint of its effect on the transmitted voltages on the line conductors, the resistance of the ground wire, within reasonable limits, has negligible effect. However, the resistance of iron to steep front waves may sometimes be much greater than 100 times the direct-current resistance, and it is desirable that a ground wire have an outside layer of aluminum or copper.

Case IV—Reflections Where the Ground Wire Is Disconnected.

The influence of discontinuing the ground wire on the voltage of the traveling wave on the line conductors should be considered under two conditions: First, where the surge originates in the last span having a ground wire, and therefore the voltage on the ground wire is in proportion to its height and, second, where the wave is advancing with zero voltage on the ground wire, the ground wire voltage having been reduced at previous towers.

Considering, first, the condition with full voltage on the ground wire, the transmitted voltage on the 220-kv. line will be:

$$V_{1t} = \frac{\left(-\frac{118}{323} \times \frac{85}{75}\right) V_{10}}{1 - \frac{118^2}{2 \times 323 \times 226.5}} = 0.648 V_{10}$$

as compared with $0.586 V_{10}$ where the ground wire is continuous. On the 33-kv. line the transmitted voltage will be:

$$V_{1t} = 0.677 V_{10}$$

as compared with $0.592 V_{10}$ where the ground wire is continued.

With the other condition; that is, when the oncoming voltage on the ground wire is zero:

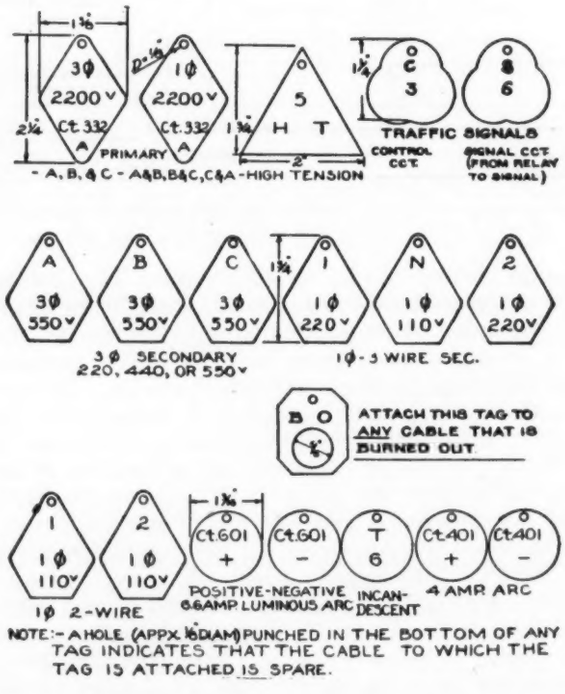
$$V_{1t} = \frac{V_{10}}{1 - \frac{118^2}{2 \times 323 \times 226.5}} = 1.09 V_{10}$$

and on the 33-kv. line:

$$V_{1t} = 1.14 V_{10}$$

Since the voltages transmitted are the voltages impressed on the station, and since the expense involved is usually nominal, the ground wires should always be continued into the substation structure, and it is usually advisable to increase the number of ground wires for the last few thousand feet into stations.

Cable Tags Used at Worcester

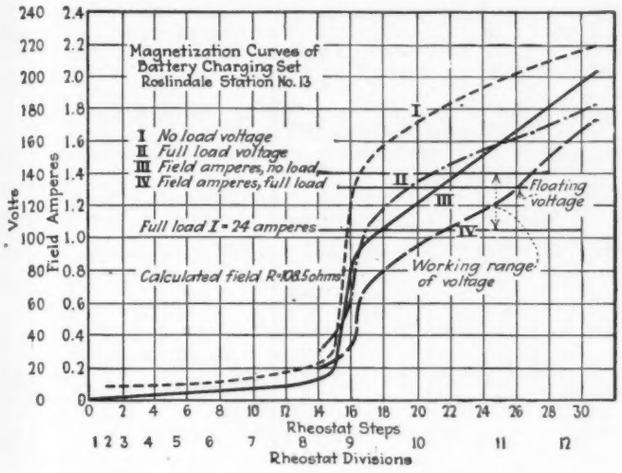

3φ 2200V Ct.332 A PRIMARY
1φ 2200V Ct.332 A
5 H T
C 3
8 6
TRAFFIC SIGNALS
CONTROL CCT
SIGNAL CCT (FROM RELAY TO SIGNAL)
- A, B, & C - A&B, B&C, C&A - HIGH TENSION
A 3φ 550V
B 3φ 550V
C 3φ 550V
1 1φ 220V
N 1φ 110V
2 1φ 220V
3φ SECONDARY 220, 440, OR 550V
1φ - 3 WIRE SEC.
B O
ATTACH THIS TAG TO ANY CABLE THAT IS BURNED OUT
1 1φ 110V
2 1φ 110V
Ct.601 +
Ct.601 -
T 6
Ct.401 +
Ct.401 -
1φ 2-WIRE
POSITIVE-NEGATIVE 6.6AMP LUMINOUS ARC
INCANDESCENT
4 AMP ARC
NOTE:- A HOLE (APPX. 1/8 DIAM) PUNCHED IN THE BOTTOM OF ANY TAG INDICATES THAT THE CABLE TO WHICH THE TAG IS ATTACHED IS SPARE.

SCHEDULE of cable tags used by the Worcester Electric Light Company is shown in the accompanying illustration. All cables are tagged on entering or leaving manholes, at the tops of standpipes and fiber pipe risers and at points of building entry. Various types of circuit are indicated by the tag shapes shown, the tags being of sheet brass, not less than 0.05 in. thick, of the dimensions standardized and attached to cables by No. 14 copper wire.

Selecting Motor-Generator Characteristics

By Wellen H. Colburn*

THE use of motor-generator charging sets with station control batteries under "floating" conditions has necessitated more careful consideration of their characteristics than formerly. Attention was called to this by damage done to batteries in automatic and unattended



Limitations of rheostat with unduly broad steps

stations. This damage resulted from prolonged overcharging arising from the instability at low voltage and light load of compound-wound machines of size to give "normal" and "gassing" charges. To overcome this difficulty small shunt generators have been in some instances adopted of capacity only sufficient to carry the station indicating lamp and other switchboard load and provide a trickle charge to the battery. This, it is claimed, maintains the battery charge under all conditions of control operation and prevents damage from overcharging.

In larger stations, where there are many switch operations and emergency lighting and special service are taken from the battery, or where other operating requirements dictate, it is still customary to use a set capable of giving the battery as near a normal charge as possible without having the set unstable. Formerly a voltage sufficient to supply a "gassing charge" was considered requisite. This was about 170 volts for a 60-cell battery and resulted in a machine which at floating voltage was so far down the magnetization curve as to be very unstable. Experience now indicates that a maximum voltage of 140 is ample and provides a steadier machine.

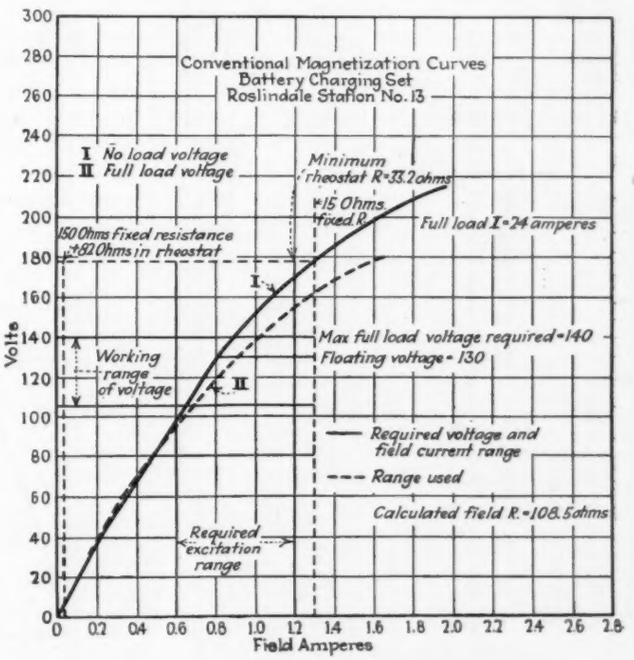
The 60-cell floating voltage usually ranges between 126 to 132, corresponding to cell voltages of 2.1 to 2.2. Under conditions of complete discharge to 1.75 volts per cell, a minimum voltage of 105 is met. Thus the useful range of the charger is comprehended within 35 volts or less. It need have a minimum not less than 105 or a maximum greater than 140, and to permit close control of charging rate should have small voltage steps, 1 volt or less, particularly in the floating range, which is very light load. This requires nothing special in the design of the generator, but only proper selection of the rheostat. A vernier rheostat will provide this, but requires multiple adjustment for each setting.

A recent installation of a compound-wound battery-charging set indicated the importance of such selection. The specification called for maximum full-load voltage of 140 and operating "floating" cell with a 60-cell storage battery. The indicating lamp load was given. Reports after installation indicated difficulty in holding or setting the machine at the predetermined floating voltage of 130 because the rheostat steps were too broad. Therefore, no-load and full-load magnetization curves were run using rheostat points rather than field current for abscissas. The conventional magnetization curves were plotted to make sure that the characteristics of the machine were not peculiar.

Rheostat Steps Unsuitable

The rheostat face plate had no definite steps, but was divided into twelve equal divisions. Accordingly, on the no-load run the handle was turned carefully until a change in voltage was noted, that point considered a step and a mark placed on the dial to show its position. These settings were duplicated for full load and the curves obtained. Similar tests as a shunt machine indicated the unsuitability of that operation.

Both the no-load and the full-load curves show the rheostat furnished to be the cause of the machine's failure to meet the specifications and with the field current curves indicate why. About half the lower and nearly as much of the upper end of the rheostat is useless, while in the operating range there is almost no control of volt-


Conventional Magnetization Curves Battery Charging Set Roslindale Station No. 13
I No load voltage
II Full load voltage
Minimum rheostat R=33.2ohms
+15 Ohms fixed R
Full load I=24 amperes
150 Ohms fixed resistance +82.0hms in rheostat
Working range of voltage
Max full load voltage required=140
Floating voltage=130
Required voltage and field current range
Range used
Calculated field R.=108.5ohms
Required excitation range
Volts
Field Amperes

Improvement in voltage control with rheostat of finer adjustment range

age. This is because the rate of rise of the field current cannot be governed by the few steps left in this critical range of the machine at or below the knee of the magnetization curve.

Consideration of the conventional magnetization curves

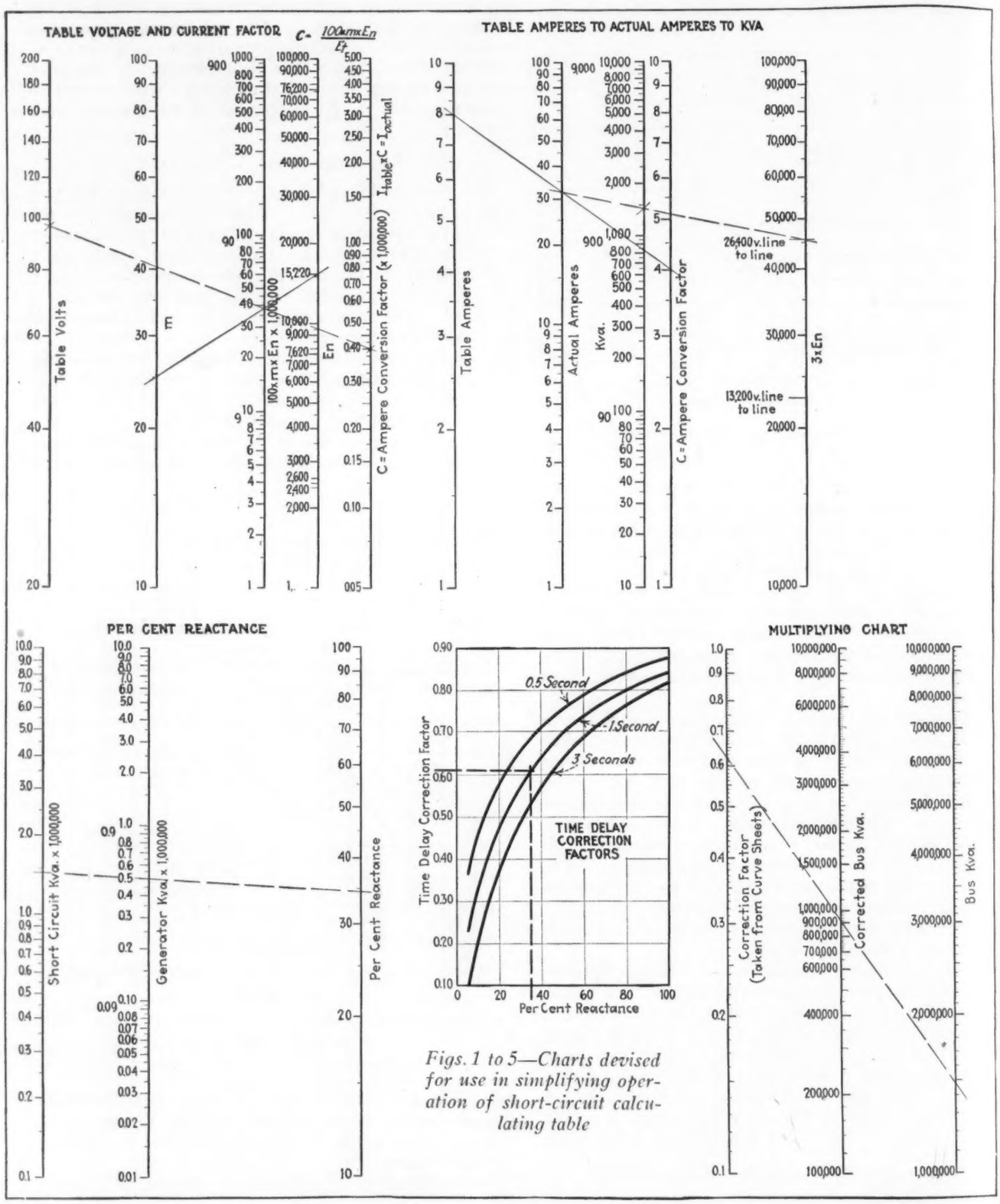
*Electrical engineer with the Edison Electric Illuminating Company of Boston, Mass.

shows that this machine had too high a maximum voltage, i.e., was working too low on the magnetization curve. It also indicates what limits of field circuit resistance, indicated therein, would make it perform satisfactorily. Consequently, a new rheostat of 83 ohms resistance with finer adjustments, together with a fixed resistor of 15 ohms, was substituted by the manufacturer for that furnished with the machine. This resulted in a fine adjustment of voltage over the operating range which has proved satisfactory.

Time-Saving Charts Facilitate Use of Calculating Table

By Raymond C. R. Schulze
Public Service Electric & Gas Company

CERTAIN calculations are necessary in order to make a set-up on a short-circuit calculating table, such as is used by the Public Service Electric & Gas Company for



Figs. 1 to 5—Charts devised for use in simplifying operation of short-circuit calculating table

system determinations. Also, it is sometimes desirable to convert current readings into actual amperes while using the table, especially if possible future changes in the system layout are being considered. In order to simplify these calculations the accompanying charts were developed. Slide rule accuracy is not always obtainable, but they will be found quite useful where an approximately correct answer is sufficient, as in a preliminary analysis of the data.

The chart of Fig. 1 is based on the formula

$$C = \frac{100 \cdot m \cdot E_n}{E_t}, \text{ or } C \cdot E_t = 100 \cdot m \cdot E_n$$

where C = factor by which to multiply the amperes read on the table ammeter, in order to obtain the actual amperes.
100 = ohms per unit of resistance (or per "per cent") of this particular table.
m = factor to convert actual ohms to rheostat setting.
E_n = volts to neutral, on which reactances were calculated.
E_t = direct current voltage of generator supplying the table.

The values 100, m, and E_n are known. Whenever possible, C should be made some even figure, such as 100,000, so as to eliminate or simplify the slide rule work after the readings have been taken. The chart of Fig. 4 allows E_t and C to be easily determined.

A quick way to convert "table amperes" into actual short-circuit amperes and then into kilovolt-amperes is provided by Fig. 2. It can also be drawn to convert "table amperes" into kilovolt amperes directly. Rather that attempt to make this chart direct reading, the scales have been spread out as much as possible in order to improve the accuracy. The location of the decimal point can be easily determined otherwise. The per cent reactance to the fault when the total generating capacity in service and the short-circuit kilovolt-amperes are known is obtainable by means of Fig. 3.

The curves of Fig. 4 show the percentage of fault current that remains after certain time intervals, for various per cent reactances to the point of short circuit. For a more detailed discussion of the time-delay correction factor see "Calculation of Short-Circuit Currents," by Raymond C. R. Schulze, ELECTRICAL WORLD, Aug. 14, 1926. A multiplying chart, illustrated in Fig. 5, allows the multiplication of the short-circuit kilovolt-ampere as found on the table, by the time-delay correction factor, without the use of a slide rule.

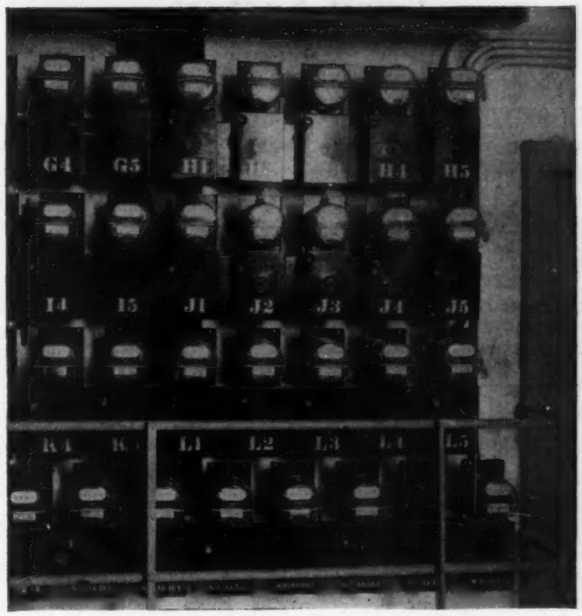
USE OF CHARTS

Suppose it is desired to study the 26,400-volt system (15,220 volts to neutral) and the factor m is 25 in the equation for Fig. 1. Placing a straight edge across m and E_n of Fig. 1 gives their product as 38.1 and rotating the straight edge about this point gives values of E_t = 95.2 and C = 400,000 as the best combination for this set-up.

To convert a table current of 0.080 amp. into actual amperes and kilowatt-amperes place a straight edge across Fig. 2 from 8 on the "Table Amperes" scale to 4 on the "C" scale giving the actual amperes as 32,000; then reading from "32" actual amperes to 45,660 on the $3.E_n$ scale results in an approximate figure of 1,460,000 kva. for this quantity.

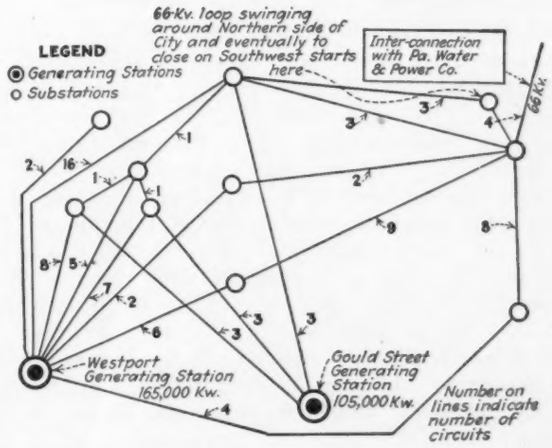
Knowing the connected generator capacity to be 500,000 kva., we can get the per cent reactance to the fault from Fig. 3 (34.3 per cent), the correction factor for one second from Fig. 4 (0.62), and the fault kilovolt-amperes after one second is the product of the original value (1,460,000 kva.) and the correction factor (0.62), or 905,000 kva., as shown on Fig. 5.

Grouped Meters Simplify Installation



IN MANY parts of the country ganged or grouped meter installations are being used to serve apartment houses and commercial or office buildings. By doing this and employing steel-clad cut-out boxes, metal troughs and terminal covers the installation can be greatly expedited, particularly when the frame supports are made up and drilled for mounting before installation. In many cases the building contractor installs the frames, cut-out boxes and bus troughs, leaving only the meter to be mounted by the utility company. This is merely one of the advantages, others being accessibility for reading and testing of meters and less likelihood of tampering with circuits.

Stations Paralleled Through Substation Feeders

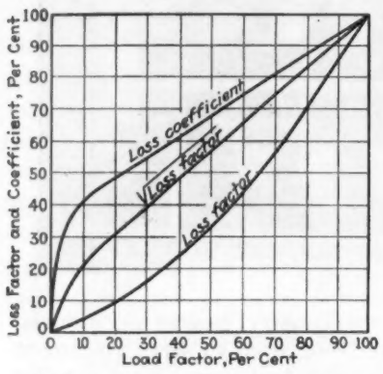

66-Kv. loop swinging around Northern side of City and eventually to close on Southwest starts here
LEGEND
Generating Stations
Substations
Inter-connection with Pa. Water & Power Co.
66 Kv.
Westport Generating Station 165,000 Kw.
Gould Street Generating Station 105,000 Kw.
Number on lines indicate number of circuits

ANOTHER example of loose coupling of generating stations exists at Baltimore, where the Westport and Gould Street stations of 270,000-kw. total capacity are tied together only through the feeds to substations. The numbers on the lines indicate the number of feeders involved.

Relation Between Loss and Load Factors

By Richard C. Powell
Pacific Gas & Electric Company, San Francisco, Calif.

RESULTS of a study published in the Electrical World for July 14, 1928, page 59, by Messrs. Buller and Woodrow, in an article entitled "Load Factor-Equivalent Hour Values Compared" are along the line of a similar study made by the author some fifteen years ago. The results of this investigation are shown by the accompanying curves, and it is interesting and should be of value to any one studying this subject to note that the results are in remarkable agreement. Values calculated with the formula given by Messrs. Buller and Woodrow plot almost exactly on the curve "Loss Factor."



Relation between load factor and I^2R losses

The author's values were obtained from a number of loads varying from 5 to 75 per cent load factor and were easily secured with a planimeter and a special chart on which the ordinates were plotted to a scale of squares, and the axis of abscissas was divided into 24 parts, just as for an ordinary load curve. Two men working together, one reading off the hourly loads from a curve or station report sheet and the other running the planimeter over the special chart, could obtain values from a number of loads in a very short time.

Data on circuits and rapidly fluctuating loads were also obtained by means of an I^2 hour meter. This was a watt-hour meter remodeled with current coils only so that the readings were proportional to the squares of the currents.

In addition to the "Loss Factor," two other curves are shown, viz.: "Loss Coefficient" and "$\sqrt{\text{Loss Factor}}$." The curve "$\sqrt{\text{Loss Factor}}$" needs no explanation, as it is simply the ratio (Effective Heating Amperes)/(Peak Amperes). The "Loss Coefficient" has been found very useful and is defined as the ratio (Per cent annual kilowatt-hour loss)/(Per cent peak kilowatt loss). That is, to obtain the per cent of kilowatt-hours lost per year multiply the per cent kilowatt loss at the time of the peak by the "Loss Coefficient." The kilowatt loss is the value usually given in connection with circuits, generators, transformers, etc., and it is often desirable to know for a given load factor the per cent of kilowatt-hours lost. As pointed out by Messrs. Buller and Woodrow, this, of course, applies only to that part of the losses which varies as the square of the current.

The "Loss Coefficient" is also equal to the ratio (Loss Factor)/(Load Factor), since

"Loss Coefficient" = (Per cent kilowatt-hour loss)/(Per cent peak kilowatt loss)

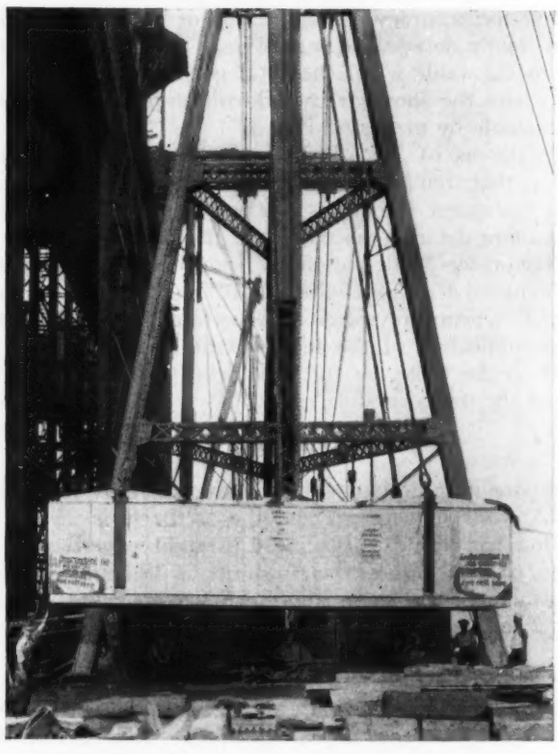
$$= \frac{(\text{Loss Factor}) \times (\text{Peak Loss}) \times 8{,}760}{(\text{Load Factor}) \times \text{Peak} \times 8{,}760} = \frac{\text{Peak Loss}}{\text{Peak}}$$

For example, a line with a copper loss of 10 per cent of the delivered peak with a 40 per cent load factor will have an annual kilowatt-hour loss of 6.1 per cent of the delivered kilowatt-hours; with a 20 per cent load factor this will be 4.8 per cent, and with 5 per cent load factor 3.3 per cent.

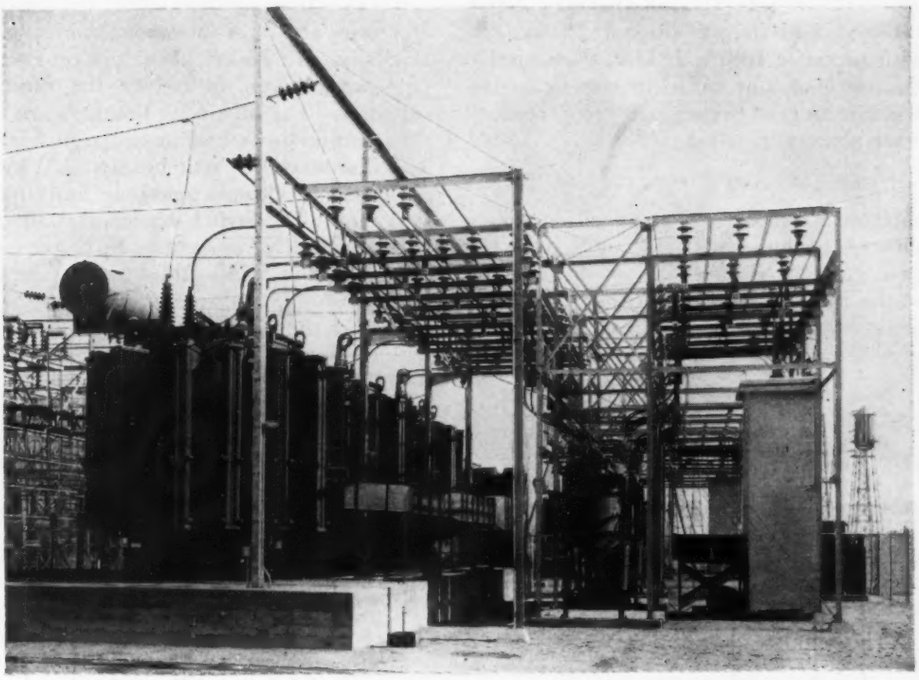
It will be found that the "$\sqrt{\text{Loss Factor}}$" curve is a straight line between 20 and 100 per cent load factors and the arc of a circle between 0 and 20 per cent.

To illustrate use of the curves, assume a line having a resistance of one ohm and carrying 100 amp. with a load factor of 40 per cent. The peak loss is then 10 kw. The equivalent average or constant current which will produce the same annual loss is the $\sqrt{\text{loss factor}} \times$ the current. From the curve the $\sqrt{\text{loss factor}}$ is 0.48 and this times 100 = 48 amp. The annual loss is $\frac{48^2 \times 1 \times 8{,}760}{1{,}000} = 20{,}200$ kw.-hr. The same results are obtained with less calculation by taking the loss factor from the lower curve and multiplying by the peak loss and the number of hours in a year, the $\frac{0.023 \times 10 \times 8{,}760}{1{,}000} = 20{,}200$ kw.-hr.

Water Delivery of 7-Ton Section of New Hell Gate Turbine



THE section shown above and other parts of the 160,000-kw. turbo-generator received recently by the United Electric Light & Power Company from the American Brown Boveri Corporation were unloaded from the ship which transported it to New York harbor by a barge crane. The barge then conveyed the equipment up the East River to the Hell Gate station, where the crates were unloaded directly at the station. The heaviest piece weighed about 60 tons and the shipping weight of the entire unit was 1,300 tons.



Outdoor starting and running oil breakers and buses and transformer bank for 50,000-kva. synchronous condenser

Lighthipe 220-Kv. Substation

Southern California Edison Company establishes important steam and hydro power distribution point. Sectionalized bus reduces breaker duty and adds to flexibility

By R. B. POLLOCK

Department of Engineering, Southern California Edison Company, Los Angeles

TO PROVIDE additional switching facilities necessitated by increase in load and generating capacity, the Southern California Edison Company recently constructed a new 220/66-kv. transmission substation. It is known as the Lighthipe substation, being so named in honor of the late J. A. Lighthipe, formerly chief electrical engineer of the company. Generating capacity on the Edison system is being increased this year by the addition of a new hydro plant at Big Creek of 90,000 kva., a second unit at Big Creek No. 8 of 35,000 kva. and a new steam plant at Long Beach of 100,000 kva. Lighthipe was built to serve as a distribution point for this power. The new hydro plant will be known as Big Creek No. 2-A and the new steam plant as Long Beach No. 3.

Lighthipe substation is about 9 miles north of Long Beach, Calif., midway between the new Long Beach steam plant No. 3 and Laguna Bell 220-kv. substation. The location and interconnections in the 220-kv. and 66-kv. networks make Lighthipe one of the largest and most important substations on the system. Lighthipe can be fed by two 220-kv. circuits from the new Long Beach steam plant No. 3 and also by two 220-kv. circuits from Laguna Bell substation, which is tied in with the Big Creek hydro-electric plants and 220-kv. transmission system. Six 66-kv. circuits connect Lighthipe with the old Long Beach steam plants No. 1 and No. 2. These connections provide for utilizing either steam or hydro power as desired.

If all of this power were fed into one common 66-kv. bus, larger oil circuit breakers would be required than is considered economical. Therefore the bus was divided into three sections with supply circuits feeding each section. The load circuits are taken off the end sections so that the diversity of load can be taken care of by connecting the center section to either end section. In order to further limit the short circuit current, the 66-kv. distribution substations in the district are fed by radiating feeders from Lighthipe and not connected to the other 220-kv. transmission substations such as Laguna Bell or Eagle Rock.

At present two 75,000-kva. transformer banks provide the necessary capacity between the incoming 220-kw. lines and the 66-kv. bus and two 50,000-kva. synchronous condensers supply the reactive kilovolt-amperes for voltage regulation and power-factor correction. The ultimate plans call for double the present transformer and condenser capacity. The substation site and rights-of-way have ample space for two additional 220-kv. circuits to Long Beach steam plant No. 3, the ultimate capacity of

which is 800,000 kva., and four additional 220-kv. circuits to tie in with probable future 220-kv. transmission substations. The site is also of sufficient size to accommodate a bus structure to take twenty-six 66-kv. feeders, eleven of which are already installed.

Buses and Switching

The switch racks are located and arranged so that a maximum number of feeders can be brought in. The 66-kv. feeders are carried on multi-circuit towers and dead-ended near the rack on self-supporting poles. By this arrangement a neat and orderly appearance is obtained. The present and future transformer banks have been assigned permanent positions near the center of the switch racks, and the feeders are installed near the ends, where they can be interchanged or others added with minimum difficulty. Lead-covered cables, carried in a system of tunnels and fiber ducts, are used for controlling this equipment.

The 220-kv. switching equipment, an end view of which is shown in one of the accompanying illustrations, is similar in design to the Edison company's previous installation. Each circuit is dead-ended to the high steel structure in the center, then dropped vertically to a branching point, each branch passing through a disconnecting switch, an oil circuit breaker and another disconnecting switch to a bus. This arrangement allows each circuit to be energized from either bus, thus giving flexibility in switching and permitting the apparatus to be serviced without de-energizing the circuit. The buses and taps are of 4-in. wrought-iron pipe, supported by stacks of five 73-kv. insulators on concrete posts. Iron pipe was chosen to reduce the number of insulating supports. The oil circuit breakers are rated to carry 600 amp. continuously and to interrupt 5,900 amp. at 220 kv. The disconnecting switches are 220 kv., 600 amp., each composed of three single-pole units mounted on a steel structure. The switch blades are hinged at one end and open vertically upward. Springs counterbalance the weight of the blades, thus making it easy to operate all three poles by hand with a single lever.

One of the 75,000-kva., 220/66-kv. transformer banks with the 66-kv. bus and circuit dead-end structure is here illustrated. A novel cooling system is used on the transformers. Each transformer is provided with its own blower, which forces air along the surface of the radiators. Up to about 60 per cent of the rated capacity of the transformers no forced draft is required, but with a further increase in load a thermostat automatically starts the blower. Each complete blower unit is mounted on a truck and can be moved onto the transformer transfer car if desired.

The general design of the 66-kv. switch rack is the result of a long period of development by Edison engineers and is similar to previous company installations, but with improvements in many of the details. From the accompanying single-line diagram it will be seen that each circuit can be energized from either or both of the two 66-kv. buses through separate oil circuit breakers. This gives flexibility in switching and makes possible

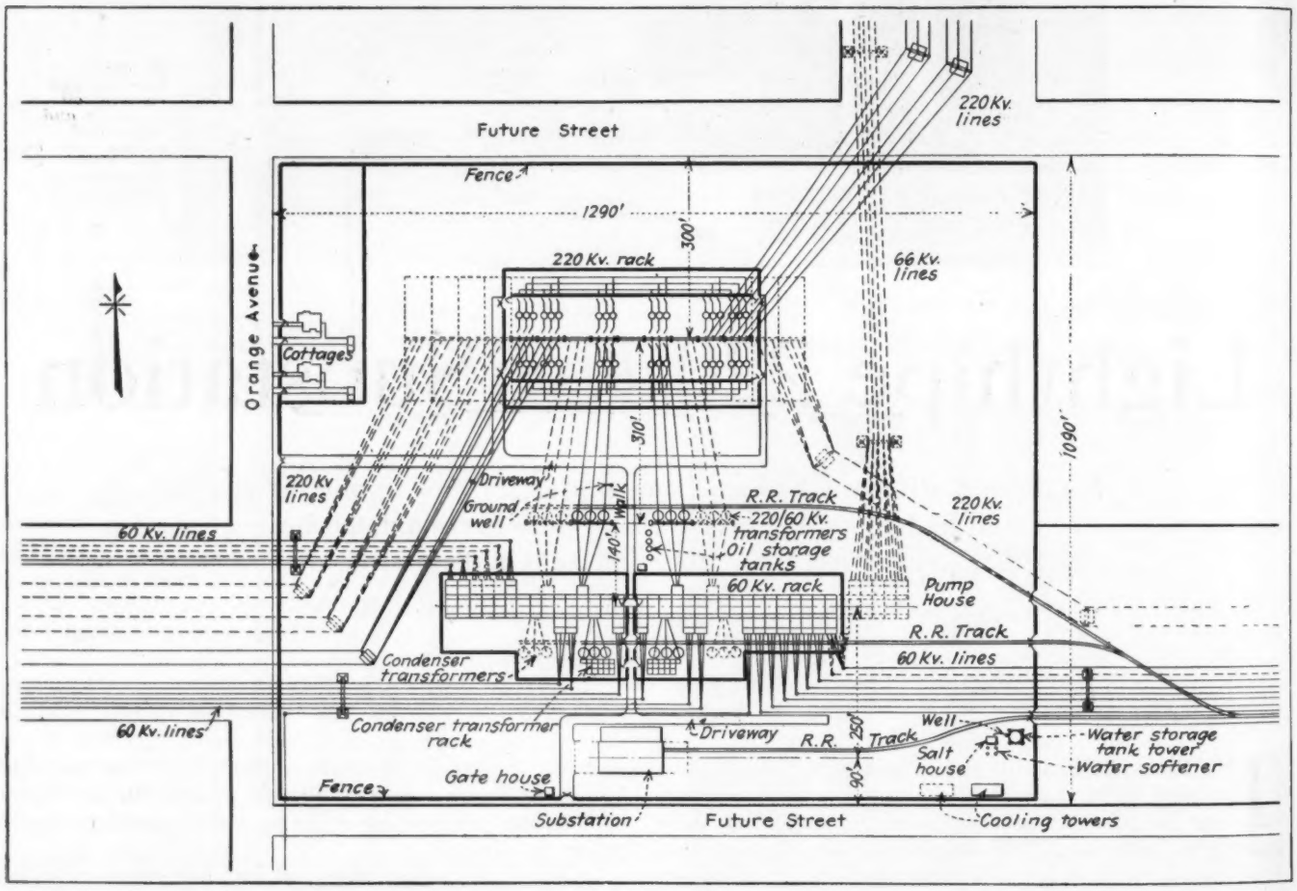
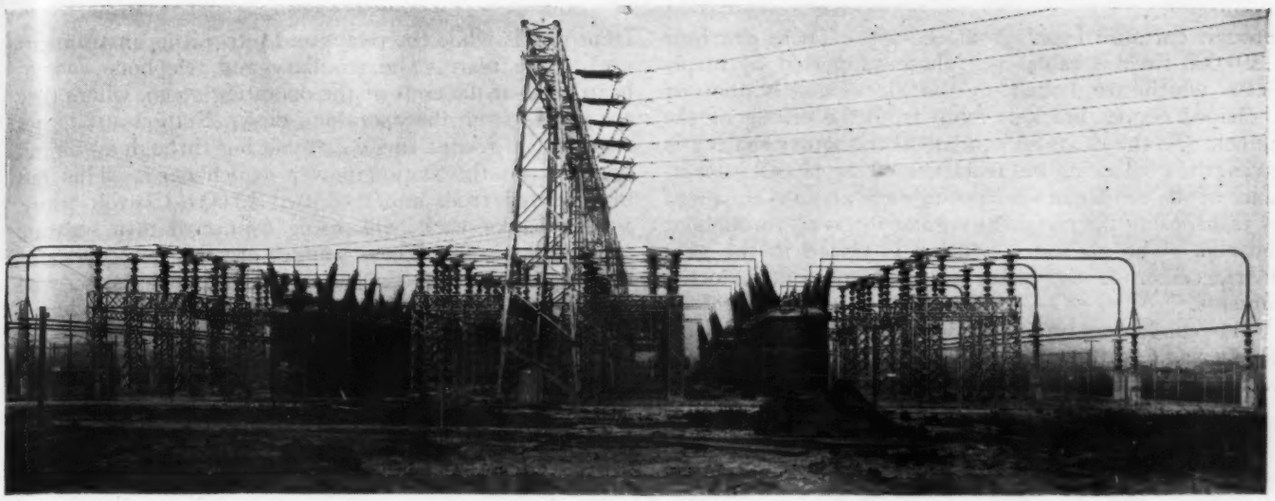


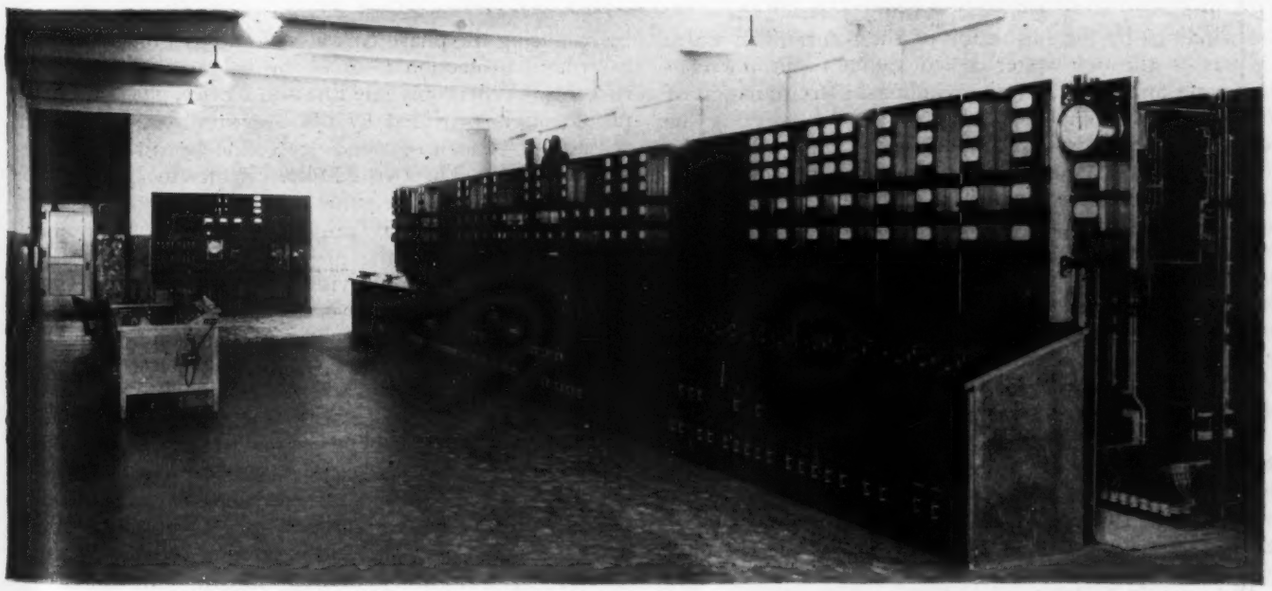
Fig. 1—Plot plan of 220-kv. substation showing arrangement of lines and equipment



220-kv. bus and oil circuit breakers at Lighthipe substation of conventional Edison design, using iron-pipe bus supported on pillar-type insulators with no overhead steel bus structure

servicing of most apparatus without de-energizing the circuit. The two buses are installed above and between the two oil circuit breakers. Each is connected through a disconnecting switch, and oil circuit breaker and another disconnecting switch to the incoming circuit, which is dead-ended to one side of the rack. Air-insulated current transformers mounted on top of the rack are used for metering the total current in the circuit. An inclosed-gap, auto-valve lightning arrester is placed on concrete piers beneath each feeder. Disconnecting switches with grounding attachments are provided for disconnecting the arrester or grounding the circuit. Two potential transformers on each circuit supply the energy for metering and synchronizing. The steel structure of the rack is designed and braced so that the operating aisles are not obstructed. A large number of safety screens are used to prevent workmen from coming in contact with a live conductor while doing maintenance work. The space under the circuit breaker foundations is used for control cable tunnels.

Two synchronous condensers in the substation building are each capable of supplying 50,000 leading reactive kva. at 13-kv., zero power factor. Each condenser has its own 66/13-kv. transformer bank and is started from low-voltage taps on the transformer secondaries. The transformer bank, starting and running oil circuit breakers and buses are installed outdoors near the 66-kv. rack, as illustrated. The equipment for each of the condensers is separate but similar in construction. This is the first outdoor installation of large condenser switching equipment by the Edison company, as outdoor, high-voltage, heavy-current-carrying breakers have not heretofore been available. The transformer secondaries are connected to the running and starting buses on the rack. These are in turn connected to the condensers through the running and starting breakers. "Kerite"-insulated cables, placed in a tunnel, carry power to the condensers from the outdoor switching equipment. The concrete structure on the right-hand side of the rack shown in the illustration is an extension of the tunnel, into which the power is taken



Operating room and main switchboard for controlling 150,000-kva. Lighthipe substation

through entrance bushings at the top. There are four 1,250,000-circ.mil cables per phase supported by maple cleats which are bolted to the sides and bottom of U-shaped copper brackets hung from the ceiling of the tunnel. To the cleats an equilateral triangular spacing is given, thus balancing the reactance of the phases. Reactance of the conductors composing each phase is equalized by transposing the phases at regular intervals throughout the run. The ground conductor is placed in the geometric center of the phase group to prevent inducted currents.

The condenser transformers are cooled by air jets directed against the radiators from an air blower for each bank. The condensers are cooled with air forced through the windings by the fan action of the rotor. The warm air passes through water-cooled radiators in the condenser pit and returns to the windings. Recirculation of the air in the completely inclosed system prevents the accumulation of dirt in the machine.

The concrete and steel substation building consists of a high and a low section. The high section houses the condensers and the lower portion contains the control and auxiliary equipment. There is a 100-ton crane in the condenser room and a pit provides headroom for removing the transformer cores from their tanks. The low section of the building has two floors and a basement. The operating room and main switchboards are on the first floor while the station power switchboard, battery and office are on the second floor. The basement is used as a cable room only. Tunnels which carry the lead-covered control cables from the outdoor equipment terminate in the basement. This makes a very convenient and flexible arrangement for accommodating the large number of cables terminating at the switchboards.

The main switchboard, as illustrated, is of the inclosed benchboard type with front and rear panels. The control switches and indicating instruments are mounted on the front panels while the relays and integrating instruments are on the rear. The auxiliary and telephone switchboards are at the ends of the operating room, where they are visible from the operator's desk. Station auxiliaries are supplied from a single 220-volt bus through air circuit breakers on the station power switchboard. This bus may be fed from either of two 13,000/220-volt transformer banks, each bank being connected to a separate source of power. These sources are the two condenser transformer banks. Each station power bank and its oil circuit breaker is installed outdoors with the condenser switching equipment. A 125-volt storage battery supplies current for the indicating lamps and for operating the oil circuit breakers. A part of the station lighting is automatically connected to the battery in case of alternating-current failure.

All circuits, buses, transformers and condensers are protected by means of relays as shown in the accompanying diagram. The two 220-kv. circuits to Laguna Bell are protected against phase-to-phase faults, when both lines are in service, by balancing the phase currents of the two lines. Phase-to-ground protection is given by balancing the residual currents. When only one line is in service, phase-to-phase protection is provided by the use of directional power relays and phase-to-ground protection by directional residual relays. The two 220-kv. circuits to Long Beach steam plant No. 3 have similar protection.

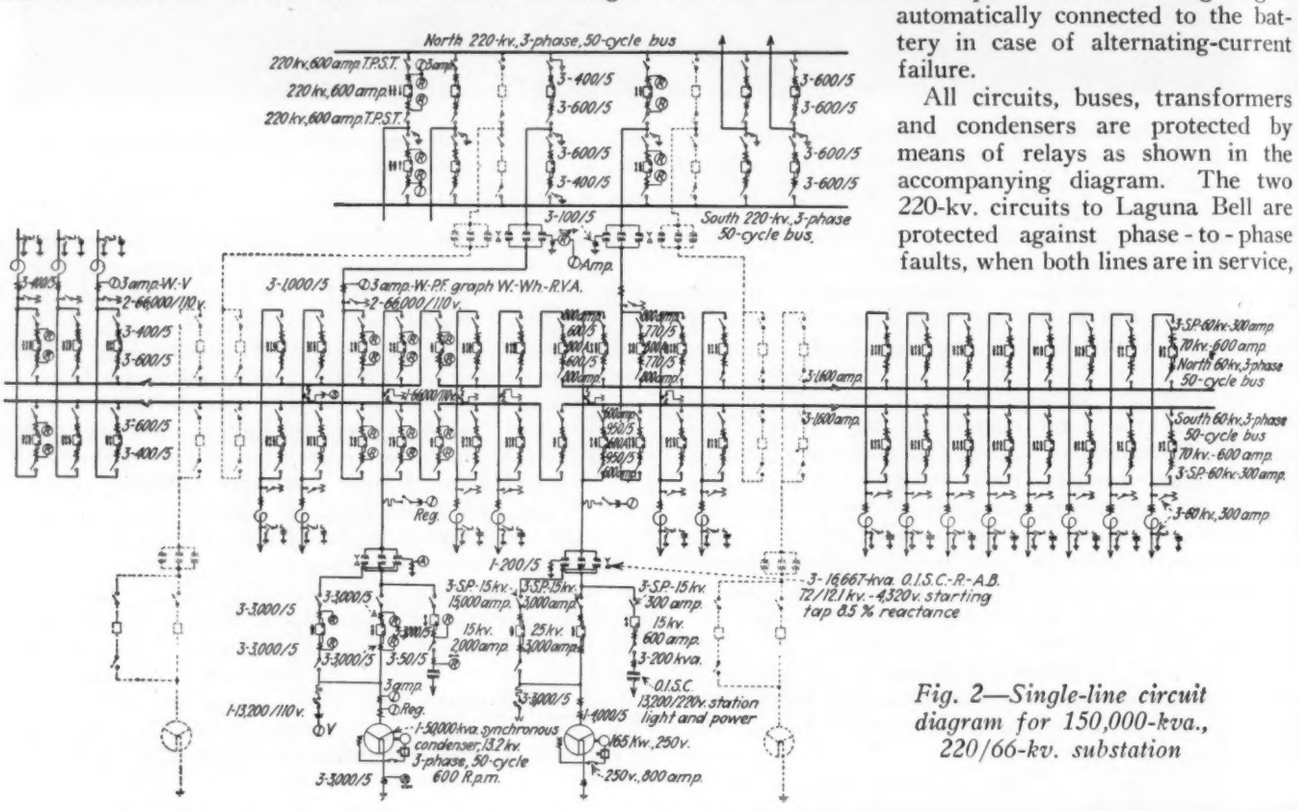


Fig. 2—Single-line circuit diagram for 150,000-kva., 220/66-kv. substation

Each 220-kv. bus is provided with bus differential protection, based on the principle that the sum of the currents entering and leaving each phase of the bus is zero, except when a fault occurs on the bus. The current transformers in each phase of all circuits connected to the bus have their secondaries paralleled and connected to an over-current relay. These relays clear all of the circuits tied to the bus. Energy for the 220-kv. relays is supplied from bushing-type current transformers in the oil circuit breakers.

Both of the 220/66-kv. transformer banks have differential current protection opening the breakers on both sides of the banks. The 66-kv. circuits feed the various distribution substations in duplicate and are protected by current balance relays similar to the 220-kv. circuits, except that when only one of the pair is in service phase-

to-phase protection is given by over-current relays instead of directional power relays. Phase-to-ground protection is provided on the single circuits by means of directional residual relays. Differential protection on the 66-kv. bus is similar to that used on the 220-kv. buses, except that relays are provided for each section of the bus instead of for the entire bus. The 66-kv. relays are energized from bushing-type current transformers.

The condensers and their transformers each have differential current protection. Bushing-type current transformers in the condenser starting and running breakers are connected with those in the 66-kv. breakers for transformer protection. To avoid a high circulating current through the relays when a condenser is being started, there are installed in the starting and running breakers bushing-type current transformers of such ratio that approximately equal currents are obtained in the current transformer secondaries on both sides of the bank under starting and running conditions. The secondaries of the current transformers in the starting and running breakers are connected in parallel, but since only one of the breakers is closed at a time the current is supplied from the energized current transformers only. The other set takes negligible current owing to its high reactance when no current is flowing in its primaries. This arrangement makes a low relay current setting possible and gives better protection than could be obtained with the high relay current setting necessary when no correction is made for the starting current. The current taken by the station power service is compensated for in the transformer differential circuit. The transformer differential relays trip the 66-kv. and the condenser breakers.

Condenser protection is provided by use of another set of current transformers in the starting and running breakers. These current transformers are balanced against a set of standard-type current transformers in the condenser neutral leads. The condenser differential relays trip the condenser breakers and the solenoid valve on the CO_2 fire extinguisher. The CO_2 gas is injected into the condenser to prevent damage to the windings by fire should the fault be in the machine. The fire extinguishing system may also be set into action by a thermostat in the machine or by remote-control break-glass stations located at strategic points throughout the plant.

Excess moisture in the condenser, due to a leak in the cooling coils, is shown by a moisture indicator. To give the warning, advantage is taken of the change in resistance of an absorption element in the condenser pit.

Excitation of the condensers is reduced during a flash-over on a 220-kv. line by cutting resistance into the exciter-field circuits. This is done through the operation of relays energized by the current in the secondaries of current transformers in the grounded neutrals of the 220/66-kv. transformer banks.

An annunciator on the operator's desk gives a visual and audible indication of trouble such as the automatic tripping of breakers or the overheating of the transformers. The desk also carries a telephone switchboard which connects the operator with the chief dispatcher and with other substations. The operator can also communicate with his assistants by means of horns and telephones distributed throughout the station.

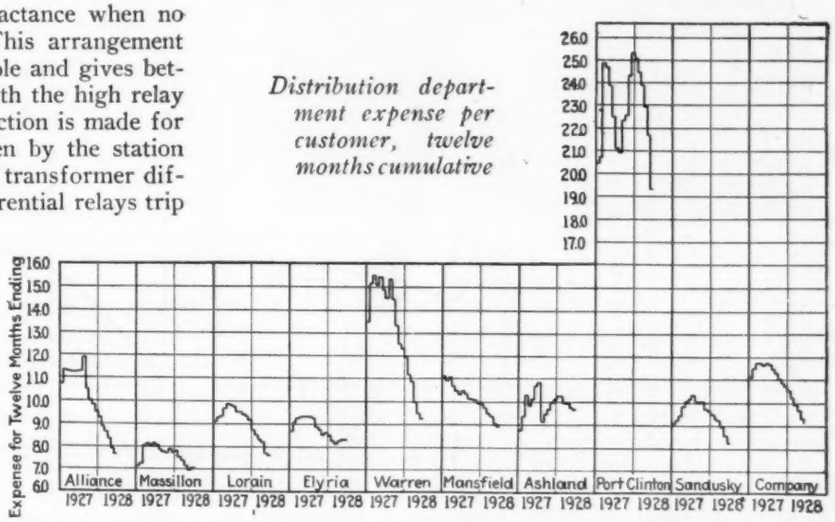
Duplicate pipe lines for handling the oil are run from a central pump house to all oil circuit breakers and transformers. One line is used to drain the apparatus and the other to return the oil to the main, clean-oil supply reservoir after filtering.

Water is supplied from a well and a 20,000-gal. storage tank on the property. The tank is on a 70-ft. tower and can be filled by either a centrifugal pump or an air lift. The condenser cooling water is treated in a softener before being supplied to the condenser cooling system. The cooling is obtained by circulating the water through surface coolers in the condenser pits and through the cooling tower. The centrifugal pump can be used to increase the pressure of the water when used for fire fighting.

Reducing Distribution Expense

DISTRIBUTION department expense per customer in the nine divisions of the Ohio Public Service Company has been materially reduced during the last year by economies in labor and material expense. Reductions amounting to as much as $6 per customer have been accomplished in some instances, and the over-all average for the company dropped from $11.75 to $9.15 per customer. These expenses include charges for labor and material used in operation and maintenance of distribution system but do not include new construction for which capital investment is made.

Distribution department expense per customer, twelve months cumulative



The savings have been effected largely by reason of a monthly interchange of distribution expense data between the distribution superintendents of the different divisions. Each month the distribution department expense per customer for the last twelve months is compiled for each division. These figures are used to plot a cumulative curve for each division and the average for the company. A copy of this curve, which is shown here, goes to each division for comparative purposes. Division superintendents can tell at a glance if their expenses are out of line and take steps to correct excessive expenditures.

The savings have been effected almost entirely through careful planning of work, stopping small leaks and taking advantage of opportunities to economize on time and material. It will be seen that there is a very marked downward trend in the curve of distribution expense per customer for all of the divisions, and this is reflected in the total for the company.

Bus Stresses Under Short Circuits

A SIMPLE general form for electromagnetic force during short circuits covering the customary designs of rigid bus structures was given in a report compiled by the Commonwealth Power Corporation of Michigan and presented to a recent meeting of the electrical apparatus committee of the Great Lakes Engineering Section, N.E.L.A. This formula and a résumé of the manner of its application are given here.

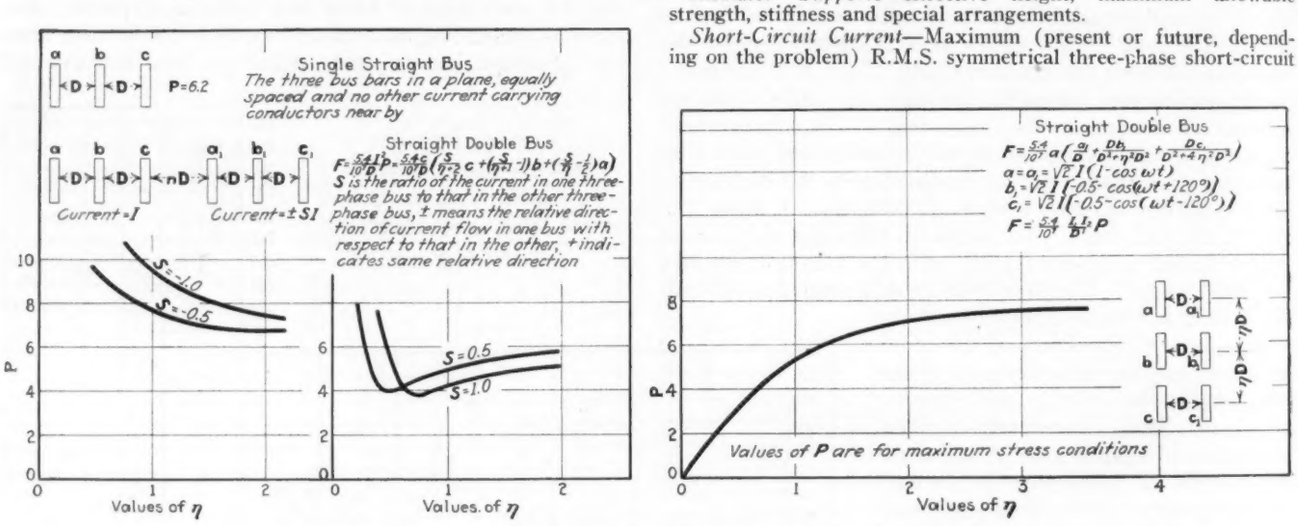
The values derived from the formula represent the maximum electromagnetic forces, it being assumed that the mechanical stresses on the conductors and on the supports are directly proportional to them.

The formula is:

$$F \text{ (Electromagnetic Force)} = \frac{5.4 I_1 I_2}{10^7 D} K^2 P$$

In determining the factor P consideration has been given to the phase relations of the currents involved, the ratio between peak and R.M.S. current values, symmetrical versus maximum unsymmetrical short-circuit currents and the number and geometrical arrangement of the current-carrying conductors. The values shown on the curves for the factor P were obtained by solving the equations for the usual maximum conditions.

The inertia and damping action of the busbar insulator structure and the current decrement all serve to limit the effect of any mechanical vibration and resonance which might occur. Therefore, it may be assumed that for practical purposes the maximum stresses as given by the above formula are reasonable and sufficient to cover the probability of mechanical resonance.


Single Straight Bus
The three bus bars in a plane, equally spaced and no other current carrying conductors near by
P=6.2
Straight Double Bus
S is the ratio of the current in one three-phase bus to that in the other three-phase bus, ± means the relative direction of current flow in one bus with respect to that in the other, + indicates same relative direction
Current = I
Current = ±SI
S=-1.0
S=-0.5
S=0.5
S=1.0
P
Values of η
Values of η
Straight Double Bus
Values of P are for maximum stress conditions
Values of η

Values for "P" used in calculating short-circuit stresses in buses

Symbols

The symbols used in the formula and later are:

- D = Clearance between conductors (inches).
- f = Fiber stress (taken as 20,000-lb. per square inch for copper).
- F = Maximum electromagnetic force per conductor (pounds per foot of conductor).
- I = R.M.S. symmetrical three-phase short-circuit current (amperes).
- I_1 = I of bus No. 1 or conductor No. 1, etc.
- I_2 = I of bus No. 2 or conductor No. 2, etc.

With a single three-phase bus I_1 and I_2 are equal in magnitude and represent the R.M.S. current per phase. With two parallel buses I_1 represents the R.M.S. phase current in one bus and I_2 the R.M.S. phase current in the other. In a direct-current circuit I_1 and I_2 are equal and represent the direct-current short-circuit current.

- K = Current decrement factor (a.c. system only) usually taken as 0.90.
- L = Length of conductor span (inches).
- M = Total maximum bending moment.
- P = Factor covering the ratio between peak and R.M.S. value of alternating current, the geometrical arrangement of the conductors and the shape of the current wave, etc.
- s = Section modulus.
- S = Ratio of current in one bus to that in another bus.
- W = Total uniformly distributed force per span (pounds) $= \frac{FL}{I_2}$

The following data are necessary for the complete solution of any given problem:

Conductors—Material, size, shape, number of conductors per phase, arrangement of conductors, spacing between conductors in one phase and clearance between phases.

Bus—Relative arrangement of phases, spacing between buses, span or spacing between centers of supports, location, kind and arrangement of connections.

Insulator Supports—Effective height, maximum allowable strength, stiffness and special arrangements.

Short-Circuit Current—Maximum (present or future, depending on the problem) R.M.S. symmetrical three-phase short-circuit current. In cases of a direct-current system, use maximum short-circuit current. The current values should be those which will flow in the particular bus sections considered. Unusual operating conditions should also be considered.

Station Layout—General information as to arrangement of buses in station, sources of short-circuit current, etc.

Example of Calculation

As an illustration, assume that the bus arrangement in question consists of the following:

Three ¼x3-in. copper bars per phase. Phase clearance between bars, 10 in.

Bars arranged so that the flat wide surfaces for all phases parallel (face) each other.

The maximum R.M.S. short-circuit current through these bars is 20,000 amp.

Required to know the maximum allowable spacing of bus supports.

From curve *a* the factor P is found to be equal to 6.2 for these conditions.

Assume the current decrement $K = 0.9$.

Substituting in the general formula:

$$F = \frac{5.4 \times I^2 \times P \times K^2}{10^7 D} = \frac{5.4 \times (20{,}000)^2 \times 6.2 \times (0.9)^2}{10^7 \times 10}$$

$$= 108 \text{ lb. per foot.}$$

The maximum allowable bending moment, M, is equal to the product of the maximum allowable working strength (fiber stress), f, by the section modulus, s, of the shape and arrangement of bars. The fiber stress, f, is given as 20,000 lb. and the section modulus s of three ¼-in.x3-in. bars with faces parallel is 0.0938.

$$M = fs = 20{,}000 \times 0.0938 = 1{,}875 \text{ in.-lb.}$$

Substituting in the formula for a "beam fixed at each end"

$$M = \frac{WL}{12} = \frac{(FL)L}{12} \qquad 1{,}875 = \frac{(108L)L}{12}$$

$L = 50$ inches.

Assuming a factor of safety of 1.0, the maximum allowable spacing of the bus supports would be 50 in.

The maximum lateral stress on the supporting insulators in this case would be equal to:

$$F \times \text{Span} = 108 \times \frac{50}{12} = 450 \text{ lb.}$$

Assuming that the current is equally distributed in the bar, this stress would be applied at a point 1.5 in. above the top of the insulator cap. Considering a factor of safety of 2.0, the insulator must be strong enough to withstand a stress of 900 lb. applied at this point.

Any longitudinal or torsional stresses which might occur in this case would be very small and need not be considered.

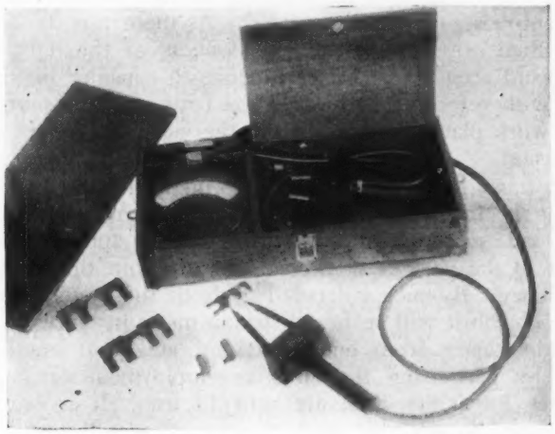
For double busbar arrangements, the same general formula should be used, but the factor P should be taken from curve b or c. This will give the maximum force in pounds per foot length of busbar. The rest of the calculations would be similar to the calculations given in the above example.

The section moduli and beam formulas necessary for the solution of problems, including tubular and solid rod buses and structures in which the bus section must be regarded as other than a "beam fixed at both ends," may be obtained from the "Standard Handbook for Electrical Engineers" or any mechanical engineer's handbook.

Testing D.C. Networks with Fuses as Shunts

By Harry B. Knights
Electrical Engineering Department
Edison Electric Illuminating Company of Boston

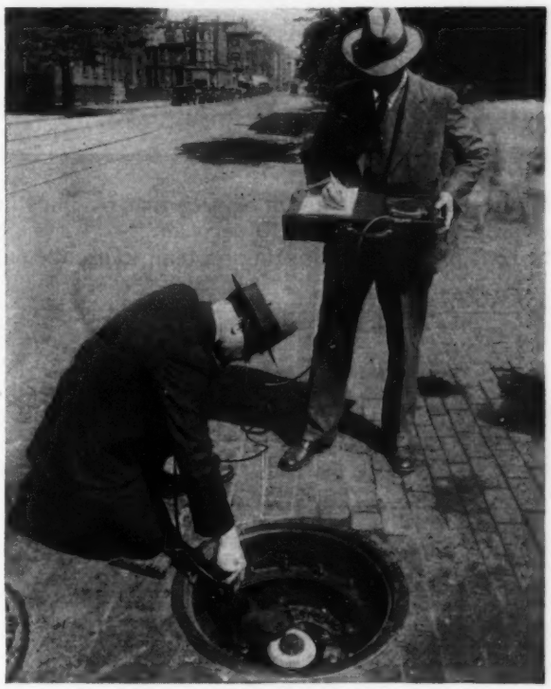
A METHOD of finding the direction and amount of current flow within reasonable limits in a direct-current network has lately been developed on the Boston Edison system, using the fuses as uncalibrated shunts. Prior to developing the method as a standard field procedure, tests were made on six General Electric 700-amp. copper, junction box fuses, considering three sources of error: (1) Differences in resistance between fuses; (2) heating of fuses; (3) variation in drop due to different positions of the point of contact. The worst deviation



Assembly of testing set

from average resistance of fuses was 6 per cent, with an average deviation of 3 per cent. Picks were set in an insulated block to insure constant distance between drop points.

The heating test was made on fuse No. 4. For about five minutes 555 amp. was applied, the fuse giving a resistance of 0.00012 ohm at 69 millivolts drop. The current was then raised to 700 amp., held five minutes and the resistance noted after quick reduction to 553 amp., viz.: 0.00013 ohm at 75 millivolts. The circuit was then broken and the fuse allowed to cool for 30



Testing current with fuses as instrument shunts

minutes. At the end of the period the current was again raised to 560 amp. and held for five minutes, the readings then being 64 millivolts, resistance 0.00011 ohm.

The average resistance from these three sets of readings is 0.00012 ohm and the greatest deviation from this average was 0.00001 ohm, or slightly more than 8 per cent.

Several different positions of the picks were tried at

TABLES I AND II—DEVIATIONS FROM AVERAGE MILLIVOLTS RECORDED AND AVERAGE RESISTANCE INDICATED BY USING FUSES AS SHUNTS

Fuse	Amp.	Average Millivolts	Resistance	Deviation from Average Resistance, Per Cent
1	555	69	0.000123	6.0
2	561	66	0.000118	1.7
3	563	63	0.000112	3.4
4	557	66	0.000118	1.7
5	555	63	0.000113	2.6
6	563	64	0.000113	2.6
	Average.....		0.000116	3.0

Fuse	Amp.	Millivolt Drop	Average Millivolt Drop	Deviation from Average Millivolts
1	555	65 to 73	69	4
2	561	64 to 69	66	3
3	563	61 to 65	63	2
4	559 555	60 to 66 64 to 73	66	6
5	555	60 to 66	63	3
6	563	63 to 66	64	2
	559	Average.....	65	3.3

Resistance calculated using average amperes and average millivolt drop = 0.000116 ohm.
Resistance using average millivolt drop + average deviation from average millivolts = 0.000122 ohm.
Resistance using average millivolt drop + worst deviation from average millivolts = 0.000127 ohm.
Using average deviation changes resistance, 5 per cent.
Using worst deviation changes resistance, 9.5 per cent.

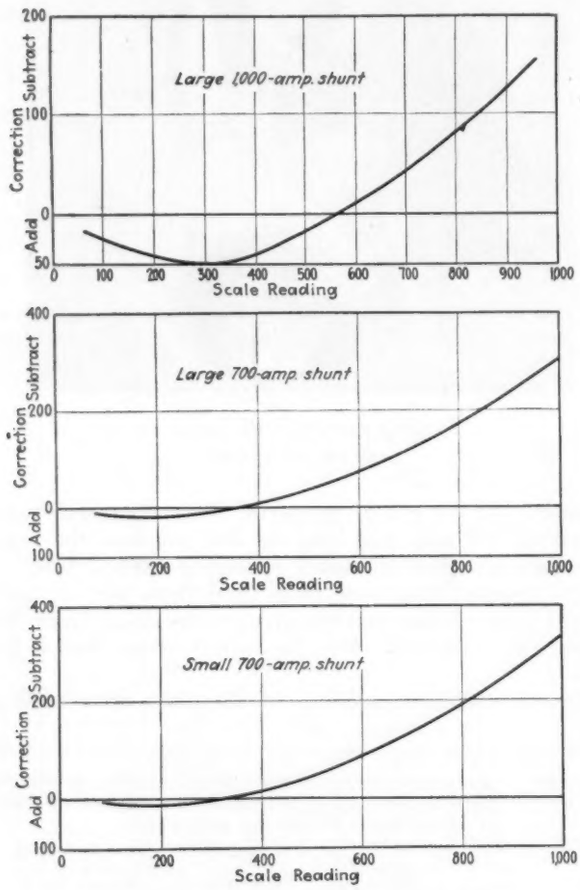
each reading and the average of these readings was used in each case considered before. Table II shows the variation in millivolt drop due to the different position of the picks on the fuse.

A summary of the three tests and percentage errors obtained is as follows:

	Average Error, Per Cent	Worst Error, Per Cent
Difference in resistance of fuses	3	6
Changes in resistance due to heating	8	8
Changes in resistance due to different position of picks on fuse	5	9.5

From the above tests it will be seen that readings may be accurate to within about 10 per cent.

The tests proved that a testing set built to use the fuses



Millivoltmeter correction curves

as uncalibrated shunts would be practical and, therefore, a set has been built as follows:

A Weston model 45 "100-millivoltmeter" scale 0 to 1,000 amp. was mounted in one end of a wooden box. The other end of the box comprised a carrying compartment for two sets of picks. One set of picks is for small type 700-amp. fuses and the second set of picks for 1,000-amp. large type or 700-amp. large type fuses. The box is provided with shoulder straps to permit supporting by an observer and is arranged to close up like a suitcase for easy transportation from place to place. The meter is provided with three sets of terminals, one for each type of fuse link; each set has just enough resistance connected in series with it to make the meter direct reading when used with the corresponding type of link.

To allow for change in resistance due to load changes, the series resistance adjustments were made for the average load found on mains protected by the particular type of fuse, 300 amp. in the case of the 700-amp. link and 550 amp. in the case of the 1,000-amp. link and calibration curves were provided where greatest possible accuracy was desired. For most measurements the meter is sufficiently accurate without correction, as, for instance, the greatest correction is, minus 10 amp. at reading of 200 amp. on the 300-amp. calibration or 5 per cent error.

Lighting and Seeing

By M. Luckiesh

Director Lighting Research Laboratory, National Lamp Works of General Electric Company, Cleveland

IT IS not unusual to regard light as a commodity of which a certain quantity is needed for workplaces; for example, an installation may be designed to yield 10 to 20 foot-candles, or perhaps on the basis of so many watts-per-square-foot, on the work plane. Such a general treatment of lighting seriously limits the lighting engineer in making the contribution to industrial efficiency that is possible by utilizing light to its fullest extent. The lighting specialist may consider his job to be more than the mere delivery of so much light at a designated spot, since light is the connecting link between the eyes of the worker and his work, and the efficiency of the worker's efforts will be increased by the speed, clearness and accuracy of vision afforded by the lighting. By lighting is meant not only quantity, but also quality and distribution of light, and various other factors important to good seeing.

While "warming up" the workplaces may suffice in the matter of heating, merely "lighting up" the workplaces is far from an adequate solution of the lighting problem. It is inadequate because it involves only the bringing of light to the object and assumes that an object illuminated to a certain intensity is clearly visible. The technique in such cases is exceedingly simple, consisting only of an estimate of the intensity of illumination required and a method for building up that intensity over the entire area to be illuminated. As the eye is the only and final criterion of the effectiveness of the lighting, it would seem to be better practice to consider lighting less with reference to the relation between light sources and work plane and more from the viewpoint of its aid to vision.

Just as a good plant engineer so distributes his motors about the factory that each is pulling its proper share of the load, so the lighting engineer can so apportion the light to the various workplaces as to attain the highest efficiency. By such a detailed study of the requirements of each job it will be found that in many instances light can be taken from one place and added at another, thereby permitting the effective employment of much higher intensities than are now in use. It is hardly necessary to say that such a program would result in substantial gains in the quality and speed of the work done.

But who is there to do this work in lighting and seeing? And who shall pay for it? Apparently the pioneering work must be done by the lighting specialist. Eventually, we believe, industry will have its experts who will work for better seeing. Something as important as seeing will not always be generally neglected.

System Records Pay

West Penn Power Company finds that maps and records of distribution and transmission systems permit large operating savings

By Merrill DeMerit

Assistant to the President West Penn Power Company

IN OCTOBER, 1922, the West Penn Power Company decided to make up some kind of maps and records of its distribution and transmission systems. The objects of these records may be outlined briefly as follows:

Data would be available as to the electrical layouts when low-voltage complaints or burnt-out transformers were reported so that an office analysis could be made.

Surveys for the elimination of excessive primary losses could be made directly from the maps.

When new extensions or additions were contemplated, details of surrounding electrical conditions would be available and the extension would be made from the more economical point; that is, so that the man who planned the extension would really know what he was doing and not select some primary line which might seem from a brief field inspection to be the best.

Surveys of voltage drop could be made from maps and records at a reasonable cost.

Low-voltage troubles could be anticipated and in many cases lessened when it would be economical rather than when such improvement would be forced by complaints.

A basis would be available to plan revamps.

To enable a survey of the distribution system to eliminate unsafe conditions. (It was planned to do this in connection with the making up of maps and records.)

Maps and Records Important

Circuit maps would be drawn up showing the location of transformers and thus facilitating the testing of these transformers by enabling systematic routes to be laid out for this work; also to insure that all transformers would be tested on any program.

Information would be available on the total number of transformers, total number of poles, miles of primary and miles of secondary wire to be used in budget work, so that excessive operating charges and excessive maintenance charges could be traced to their source, the reasons for them determined and the proper cure prescribed; also, a logical means would be available for drawing up operating and maintenance and capital budgets.

Additional men could receive field training and learn field conditions and distribution and transmission equipment, and they could be trained more easily for distribution engineering work.

While the distribution system is one of the largest divisions of the public utility plant, investigation shows that very little engineering work has been done on it, owing to the fact that it is proposed in many small parts rather than a few large parts.

A careful study of the conditions and the kind of territory, density of load, organization and methods of the company was made, and the plan maps and records were drawn up to meet the conditions. It was found in this study that some companies have records on such an elaborate scale that the cost of making and the cost of maintaining exceed the value derived from the records when completed. On the other hand, some of the records of other companies were so meager that the use of the records was very much limited. By small additional expenditures the value of their records could be doubled.

Another thing that enters into this question is the relation of other work which may be carried on at the same time on the system. For instance, owing to deferred maintenance on account of conditions which existed during the war, and to the fact that some of the West Penn Power Company's system consisted of properties taken over within the few years preceding the starting of the maps and records, the distribution system was far from being in the best of condition. Simultaneously with the drawing up of maps and records a revamping program has been carried on. This revamping program has materially improved the condition of the system. The savings due to maps and records are largely the savings in time and expense required for trips to various points on the system. Revamping has cut down such trips to less than half of those required at the beginning of the program. The savings calculated at the inception of this program would have been double those shown by the actual results. If the other activity had not been taken into consideration, this might have led to an expenditure too great to be economical.

Record System Used

After taking all conditions into consideration and all correlated activities, it was decided to make up the following records for the entire territory:

First—Base maps of 500 ft. to the inch covering all scattered territory and base maps of 100 ft. to the inch for congested territory. For various reasons the size of the sections was decided as 36 in. by 24 in. Each pole is numbered as the records in that section are made up, and the record maps show the pole number, height of pole and ownership. The maps show the size, number and phase of primary wires, the size and number of secondary wires and of street-lighting wires. All of the above is shown by code except the size of wire, which is given by a number each side of the pole at which the wire size changes. Transformers are shown by code and the size and serial number are given in each case. Lightning arresters, strain insulators, etc., are shown by simple code. Fortunately, topographical sheets of the United

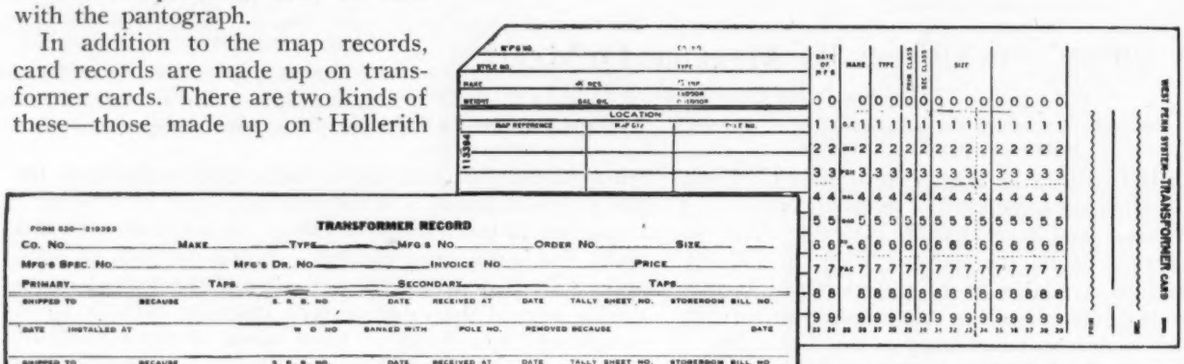
States Geological Survey were available covering the entire West Penn Power Company territory.

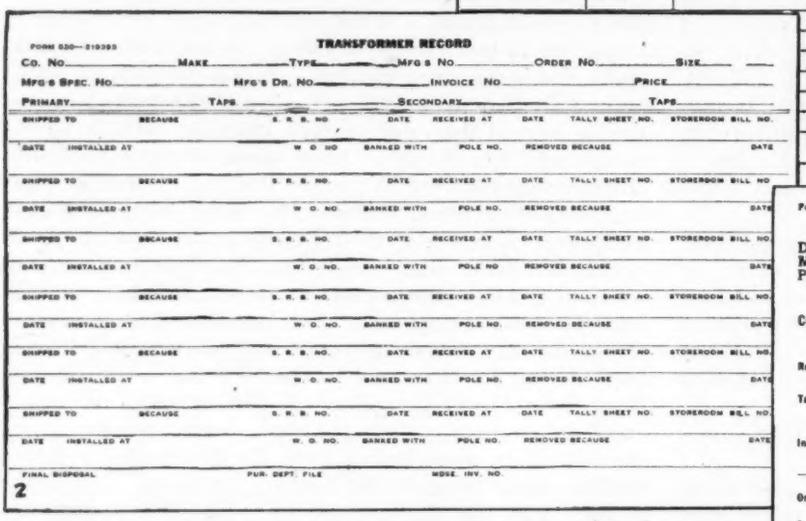
At the beginning of the program maps were enlarged for these sheets for 500-ft. base maps by use of a pantograph. Later the engineer in charge of this work developed a very ingenious machine which was built by a Pittsburgh company at a cost of $1,400. By the use of this machine maps of one scale may be traced at any other scale directly and two men of the same ability can in the same time do twenty-four times as much work at the same expense as could be done with the pantograph.

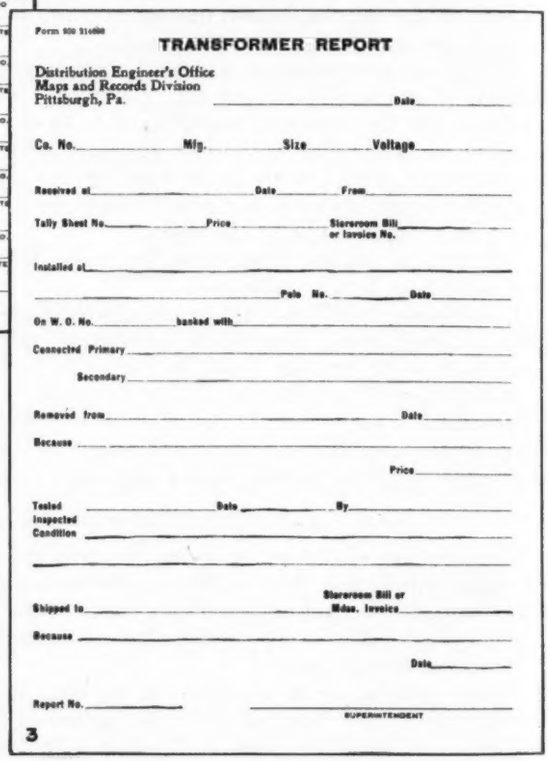
In addition to the map records, card records are made up on transformer cards. There are two kinds of these—those made up on Hollerith cards (Fig. 1) and those made up for long-hand entry (Fig. 2).

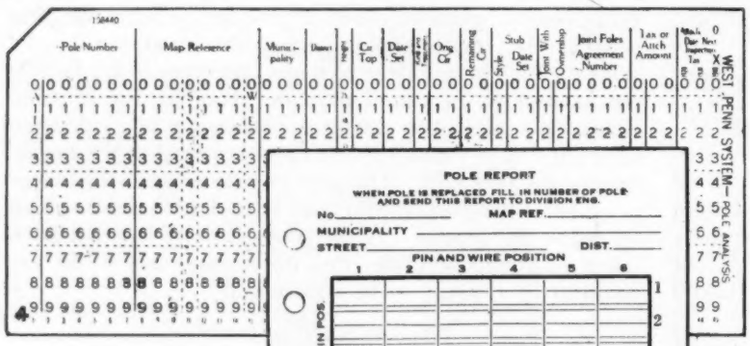
One set of these cards is kept in the central office and one set is kept in the district office. These files are kept up to date by transformer reports made up whenever a transformer is installed or removed, the report being sent into the Pittsburgh office (Fig. 3).

Two pole card records are kept. One shows only the pole number and the map section on which this pole is located. Several poles are entered on one card. This









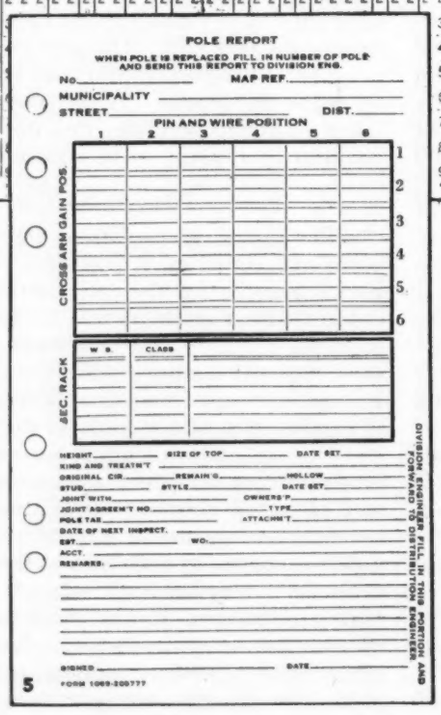


Fig. 1—Transformer record card used on West Penn system

Fig. 2—Transformer record card for long-hand entry

Fig. 3—Transformer report card for keeping record up to date

Fig. 4—Budget guide card

Fig. 5—Pole report card

card record is used as a cross-index only and is kept up to date by the routine methods which are established to keep the map records up to date. The second is a Hollerith card (Fig. 4) and is used entirely for budget purposes in determining taxes for municipal inspection and so forth. This routine is also kept up by means of a pole report which is made up by the foreman whenever a pole is replaced or a new pole is set.

The making of maps consists of two parts, the first is gathering the data in the field and the second is drawing up records from this data.

The field organization consists of about 20 to 30 men divided up into groups of three and super-

vised by an engineer competent to answer any questions as to the kind of connections or of equipment or questions regarding mapping. The office organization consists of about four tracers, two draftsmen and an engineer. The method of making up maps is as follows:

A blank map section is made up in the office and sent to the field crew of three men. This field crew corrects the map section if streets have been added or roads have been changed since the topographical sheet was drawn up. At the same time it inspects each pole, attaches the identifying number and fills in a blank pole report (Fig. 5). On these reports the wire sizes and transformer size and voltage are estimated. These reports and maps, with the poles spotted and numbered, are sent back to the office. Here the draftsmen use the data to draw up the final maps, using penciled figures to indicate the size of wire and the size of transformers. Blueprints are obtained from these prints and sent to a field checker. The field checker with a lineman drives directly to each transformer or to the place of a change in wire size, and they obtain the transformer nameplate data and use an insulated wire gage on the wire. These data also are sent to the office. The original tracings are corrected and numbers showing the wire sizes added in ink. Blueprints are made up and sent to the engineering and operating offices. Monthly reports are rendered on the cost of making up the maps and records.

Cost of the Entire Program

The entire program consists of making up 889 map sections with the corresponding transformer cards and pole cards. About 80 per cent of this work is complete. The total cost of the program when completed will be $235,000. The work has been completed in two divisions for a period of about three years. Many uses have been found for these maps and records other than those originally planned. An investigation was recently made to determine the extent of such use and the savings made as the result of this use. It was found that there were eleven different ways in which these maps and records were being used by the divisional organizations or by the district construction men and commercial superintendent. The actual annual saving for the system will be $145,018 and the actual cost of maintaining the maps and records (using the rate per division for the divisions now completed) will be $28,810. This leaves a net annual saving of $115,209. In addition, there are many ways in which these maps and records will be used to advantage but which cannot be definitely put in terms of dollars at the present time.

Savings are Tangible

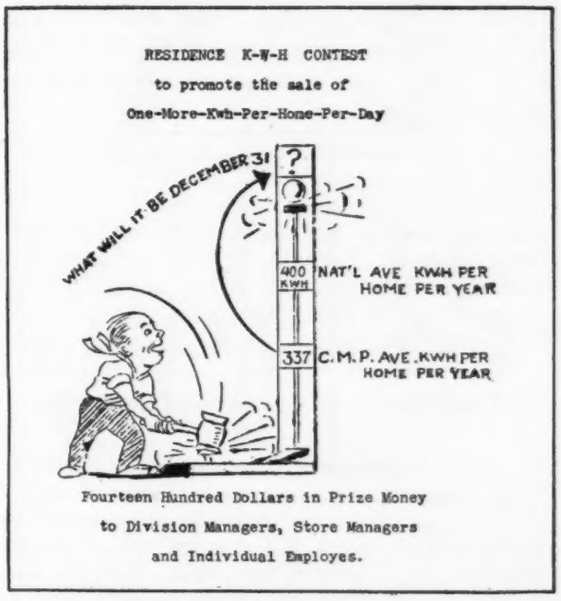
Following are two typical examples of how savings are made, in the first of which they can be evaluated, but not in the second:

1. One trip per week is saved by the division superintendent owing to the fact that he can refer to records to obtain information. This is in connection with pole replacements and broken poles. When a pole is broken it is usually reported in by telephone and the pole number is given. The division construction superintendent, instead of making a trip to the broken pole, refers to the maps and records and determines the size of pole to be used for replacement, its location and whether a shutdown will be required. (This can be determined by the voltage of the wires on the pole.) He then dispatches a crew with the proper pole and other equipment necessary to make the replacement, thus not only speeding up the re-establishment of service and the removal of a hazardous condition but saving a trip of the division construction superintendent. The saving in time in dollars per week based on the past two months' experience is $1.80. The saving in automobile miles results in a weekly saving of $2.25, or a total of $4.05 per week. An annual saving per division of $210.60 is therefore indicated.

2. Surveys of existing conditions are made from the maps and records, disclosing points where excessive losses occur, and steps are taken to improve the service and reduce the losses. This could be done in the field without maps and records, but the time and expense involved would make much of it inadvisable. Such conditions are not usually as obvious in the field as on the records.

Heavy-Duty Appliances Feature New England Kilowatt-Hour Contest

INTENSE interest has been stimulated in the sale of heavy-duty electric appliances in the New England Public Service Company properties by a residence kilowatt-hour campaign in accord with the well-known N.E.L.A. movement to increase energy consumption in the home. On the Central Maine Power Company system the campaign began last May and ends Dec. 31 in a contest of division managers, store managers and individual employees, except appliance salesmen, to add one more kilowatt-hour per day to the present usage per home in the territory of that utility. The company average for 1927 was 337 kw.-hr. per residence customer.



Cartoon announcing contest for increased residential kilowatt-hours

The appliances and points to be reckoned in the contest are as follows: Range (6 kw. or over) 1,300 points; refrigerator, 1,000 points; ironer, 900 points; cooker, 800 points, and water heater, 500 points. Convention trips are to be awarded managers whose divisions show the greatest average increases in revenue and kilowatt-hours per customer. Money prizes will be awarded employees on monthly and closing bases and credit is given for leads resulting in sales.

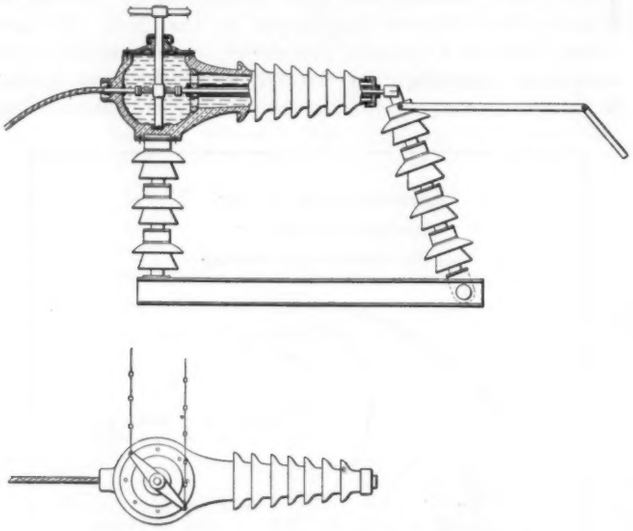
Suggested Line Section Switch

By J. A. Reynolds

Chief Engineer Cia. Agricola y de Fuerza Electrica del Rio Conchos, Camargo, Chihuahua, Mexico

At the N.E.L.A. convention in Atlantic City last June a prominent electrical engineer was asked his candid opinion in regard to air-break switches and is quoted as replying: "Some are worse than others." It is possible that the writer's experience may have been unusually unfortunate, but he is of opinion that most engineers who have had experience with this type of apparatus will admit that there is at least considerable room for improvement.

The type of switch referred to is not, of course, the pure and simple "disconnect," which in many types and styles is entirely satisfactory, but the so-called air-break



A combination oil and sectionalizing switch

switch which is supposed to be capable of interrupting moderate amperage and power at medium and high voltages. Most of these switches will successfully break moderate currents on a still day and when adequately spaced, but no air switch ever made will consistently interrupt large charging or exciting currents at voltages of 75 kv. and upward when even a moderate cross wind is blowing.

The large and costly high-tension automatic oil circuit breaker is not only without a close competitor but stands entirely by itself. There is no other switching device which can approach its enormous interrupting capacities within hundreds of thousands of kva., and the only piece of apparatus which can be substituted for it for automatically interrupting comparatively insignificant loads is the tetrachloride or the expulsion-type fuse.

The massive and costly design of the "O.C.B." is very largely due to the fact that it is automatic and is at times called upon to interrupt the concentrated power of an entire generating equipment, but the very nature of its design precludes the possibility of reducing its cost to any great extent by redesigning it for non-automatic service. It is felt, however, that there is a distinct field for such an apparatus, and, in the hope of stimulating the inventiveness of those having a far better knowledge of the subject than the writer, the design incorporated in this article is suggested as a possible basis of development.

The device consists of two distinct elements—a small non-automatic oil switch and a disconnect. These may be operated separately, serially or simultaneously, as the operating mechanism of the two elements can be combined or interlocked in various ways. The sketch shows a bushing of simple type expanding into a spherical compartment at one end provided with a cap or cover. It is suggested that, owing to its form and to the tensile strength exhibited by properly processed porcelain, the latter material might be used for this important part, but other materials, capable of being molded into the required form, could be used with perhaps greater success, though at an advance in cost.

The large aperture at the top is required for assembling the internal components of the oil-switch element and, subsequently, for inspection and contact adjustment, etc. A vertical rod which passes through a gland in the cover and is pivoted at the base of the sphere carries the moving contacts of the switch, the fixed contacts being connected to the terminals of the incoming lines. No attempt is here made to detail any portion of this apparatus, the only object in view being to introduce the general idea.

The whole is supported by and attached to a pillar insulator of conventional design, and an idea of the size of the sphere will be gained by comparing it with the supporting insulators. Although insulators and insulation may be introduced at various points of the operating rods and arms, it is evident that the upper operating levers of the three phases must be connected together by insulated rods, or something similar to the micarta chains used with certain types of insulator-mounted relays. Owing to the necessary phase spacing, however, this matter presents no insulation difficulties whatever.

When assembled and mounted, the entire sphere and bushing is filled with oil, the disk or spider of insulating material at the entrance of the bushing, through which the right-hand conductor passes, being provided with ample oil passages. Although otherwise air-tight, a small vent or valve would, no doubt, be required in order to get rid of any gas formed at the contacts. This would be installed in the cover and over the small air space.

Though the weight of the oil-filled bushing and oil-switching portion would be considerable, the standard type of built-up pillar insulator would be of ample strength for its support, and although the center of gravity would be well off the center line of the insulator stack, it would not be sufficiently so to introduce any strains which could not be readily borne by the insulators. Furthermore, no particular stresses would be introduced by the operation of either switch element. The disconnect portion of the switch requires no explanation, as, provided that satisfactory contacts are used, such a simple form as that shown will meet all requirements.

As already stated, the combination switch can be used in a variety of ways. By keeping the operation of the oil and air break separate, it could be used either as an oil or an air-break switch. A dead line, for instance, would be opened or closed by the disconnect alone, while a live transformer bank, a moderate load or a transmission line could be opened by the oil-switch portion alone, the disconnect being opened later if necessary. All loads would presumably be connected by first closing the oil-switch contacts and later the disconnect, though the sequence of operations in this case is unimportant.

Analyzing

The Investor's Viewpoint

A four-year study of the needs and desires of the security buyer uncovers some interesting and instructive facts

By Frank L. Dame
President North American Company

THERE is plentiful evidence nowadays of a wider public interest in business, because millions of people have their money invested in industrial and public utility corporations. Statistics show an enormous increase in the number of stockholders of various companies, thirty times as many security owners today as fifteen years ago, purchasing nearly ten billion dollars' worth of public utility stocks and bonds during the last five years alone. In the modern phrase, the American public has become investment conscious.

What features does the average investor look for in a public utility stock? What dividend policy does he favor? What is the dominant reason why investors in any particular company sell their stock?

These and similar problems interested the executives of the North American Company and an exhaustive survey was the result. The findings here discussed will be of interest to all company executives who may be desirous of feeling the pulse of that large and imponderable body—the shareholders.

Is this vast group of stockholders inarticulate? By no means. They do not attend meetings and they are often apathetic about sending in proxies, although in this matter there has been a noticeable increase of interest. But they do buy and sell stock, and they do occasionally write letters; thus, at times, they express themselves forcibly. Yet the letters are not numerous in the normal life of a corporation, whether they voice satisfaction, criticism or mere inquiry, and the disappearance of a name from the stockholders' list is not always absolute evidence of dissatisfaction.

What, then, can the average corporation do to read the mind of its large body of stockholders? To paraphrase a well-known cartoonist's human interest sketches, "What does an investor think about?"

Four years ago I began collecting data on that subject, and today the North American Company has the benefit of what I consider a very accurate picture of a cross-section of the public mind. During that period every person who ceased to be an owner of North American common stock has received a letter, with a stamped and addressed reply form, asking if he or she would care to tell us the reason for selling the stock. We obviously cannot keep in constant correspondence with our large number of stockholders to find out what they are thinking about, but the moment a name disappears from our books we ask this former stockholder: Why? The survey among these former stockholders is immediate and is in continuous operation.

This was, to many perhaps, a novel and unconventional idea. At first postcards were inclosed for reply, and I suppose some people were reluctant to write in such a public way reasons which might be personal; yet the replies received from former stockholders during the first year of the survey averaged 45 per cent of the number to whom letters of inquiry were sent. Later the reply form was changed from a postcard to a sealed folder, and the second year 53 per cent replied, the third year 57 per cent, and the fourth year 58 per cent, with a single month's return as high as 62 per cent. If our survey comes under the classification which in advertising circles is called direct-mail, I believe our percentage of response is remarkably high.

The North American Company has about 42,000 individual stockholders, more than 30,000 of whom are owners of common stock. In addition there are more than 90,000 individual owners of preferred stocks of the North American Company's public utility subsidiary companies. These companies, notably in Cleveland, Milwaukee, San Francisco and St. Louis, have conducted customer-ownership campaigns and are in more or less close touch with their local stockholders. The holding company, whose stock is listed on the New York Stock Exchange and whose stockholders are scattered through every state in the Union and in foreign countries, is far more remote; its stockholders have acquired their stock through bankers and brokers, not through such a security sales organization as is maintained by a local operating company.

Man's inventions for speed are insignificant compared with the speed attained by gossip—financial rumors, tips, predictions—occasionally right, usually wrong, and often pernicious, if not actually malicious. Under such circumstances, the average corporation may lose a large number of stockholders through a mere misunderstanding, which might mean a regrettable loss to the stockholders themselves and at the same time a blow to the company's reputation. How can the company's exec-

utives tell? A stockholder may sell his or her holdings through dissatisfaction with a company policy, which may be misunderstood, or through wrong information; or the sale may be due solely to a desire for immediate profit, or the need of money to buy a home or to meet a family crisis.

The Follow-Up Policy

Tracing the steps in the day-by-day interrogation of those who dispose of their North American Stock, the first is a multigraphed letter with the typewritten name and address of the stockholder carefully matched to the body of the form letter. This letter, which follows, is sent by our transfer department as soon as the stock is transferred:

Dear Sir: Because the North American Company believes in the principle that the shares of successful public utility companies should be widely held by the public, we are anxious to retain as many stockholders as possible. Hence I regret to note the recent transfer of your holdings, and shall greatly appreciate your advising me of the reasons therefor to the extent that you care to do so.

The number of our stockholders has been increasing steadily and rapidly. When we lose one we desire to ascertain whether his or her view of the company differs from that of the majority (if, in fact, it does), or if the holdings have been disposed of for purely personal reasons.

Inclosed is a folder, stamped and addressed to this office, on which various reasons are set forth. Any reason under Nos. 1 and 2 which applies may be indicated merely by a cross.

In thanking you for your assistance in the matter, may I express the hope that you will, when conditions permit, again become a stockholder in our company?

Very truly yours,
F. L. Dame,
President.

The return folder is a form widely used in Europe, a single sheet with flaps which may be folded and sealed, the back of the letter thus becoming the envelope. It is addressed to me personally, and requires no signature because the stockholder's name has been typed in one corner. The reply form is as follows:

In response to your recent letter I am glad to supply you with the following information as to why I disposed of my stock in the North American Company:

1. Desire for—a. Greater security; b. Greater yield; c. Immediate profit; d. Reinvestment.
2. On account of—a. Lack of information; b. Any policy of company; c. On advice of broker; d. Opportunity to exchange; e. Purely personal reasons.
3. Other reason (Please state).

Note: No signature is necessary, as the information is desired merely for statistical purposes.

(Please put cross opposite item indicating your answer. If check marks do not indicate information you would like to give us we shall be pleased to have it at greater length.)

Half a dozen lines of space are provided for other reasons or detailed information. Numerous other reasons have been given, as shown in the tabulation below. Many ex-stockholders who reply give more than one reason. In compiling this information we arbitrarily take the first check mark as the primary reason, although the form of the questionnaire is such that this may often be unjust to the company. The second check mark, if any, is taken as the secondary reason. And any others are necessarily not tabulated.

Permanent Record Is Kept

The survey began Sept. 30, 1924. I gained much helpful information from the replies during the next few months, but when I realized that the experiment was even more successful than I had dared to hope I decided to keep a permanent record. This compilation began May 1, 1925, and since then the percentages of replies to total inquiries among former stockholders were as follows:

	1928 Per Cent	1927 Per Cent	1926 Per Cent	1925 Per Cent
January	60	53	54	..
February	62	54	53	..
March	56	57	52	..
April	50	49	42	..
May	59	56	50	46
June	60	51	50	43
July	59	50	53	40
August	..	57	54	44
September	..	59	56	46
October	..	62	60	46
November	..	59	54	44
December	..	61	61	48
Year	58	57	53	45

Replies are received frequently several months after letters of inquiry are sent out. It will be noted that the percentage of returns has been increasing steadily. Many persons go into great detail and write letters explaining fully their reasons for disposing of their stock.

Why do they sell? Here are the reason given by 57 per cent of all stockholders who sold their stock during the twelve months of 1927. The table which follows is classified by reasons in percentage of replies received, 43.48 per cent of those who replied also giving secondary reasons:

	Primary Reasons Per Cent	Secondary Reasons Per Cent
Immediate profit	27.85	1.56
Purely personal reasons	26.67	2.54
Reinvestment	11.16	3.66
Needed money	9.20	0.78
Miscellaneous, or no reason given	3.32	0.80
Greater security	3.26	....
Dividend policy	2.65	2.42
On advice of broker	2.54	2.74
Decline, or prospect of decline	2.28	1.67
Stock loaned	2.24	....
Gift, death, transfer	2.22	0.03
Opportunity to exchange	1.59	1.36
Greater yield	1.27	0.29
Lack of information	0.81	0.58
No sale (names changed, etc)	0.81	....
Selling too high	0.72	0.60
Stock moves too slowly	0.66	0.69
Any policy of company	0.55	0.61
Fear dividend not maintained	0.20	0.43
Expect to rebuy	.....	22.72
Total	100.00	43.48

Analysis of these returns shows that of those who disposed of their stock, more than 77 per cent did so because of various needs or desires for cash, although satisfied with the investment. Aside from the small percentage of miscellaneous reasons, changes in names, and sales involving gifts and death, only 16 per cent showed any degree of dissatisfaction; of these the highest percentage, only a trifle over 3 per cent, desired greater security, $2\frac{2}{3}$ per cent were motivated by the dividend policy, and so on down to one-fifth of 1 per cent who feared the present dividend could not be maintained.

Intended to Repurchase

There is significance, I think, in the fact that more than half of the former stockholders who gave secondary reasons for disposing of their holdings indicated their expectation to rebuy North American stock. Indeed, there have been many cases where the questionnaire developed into correspondence which cleared up misunderstandings and misinformation and led the former stockholder back onto the list.

Ever since the survey began I have taken the time personally to answer inquiries, writing letters to all those whose returned questionnaires asked for information or

indicated lack of it. At the beginning the replies showed a large number of stockholders did not understand the policy of paying common stock dividends in common stock, and many were not only foregoing its benefits by selling their dividend stock but were also disposing of their principal. Steps were taken to inform all stockholders fully, and this continues to be done in the case of every new stockholder. This lack of understanding soon began to appear much less frequently, until at the present time the percentage (as given in the above table) amply demonstrate that the North American Company's stock dividend policy is favored by our stockholders.

In replying to letters I take as much pains to clarify the situation for the benefit of the owner or former owner of one share of stock as I do for the owner of 100 shares. I am interested in knowing what the investing public is thinking about, and thereby learning facts instead of having to theorize. We have learned a great deal which has been of assistance to us in formulating policies. Paradoxically, yet quite logically, we keep in close contact with the attitude of our stockholders by establishing contact with our former stockholders.

Large Mining Property Cooks Electrically

A COMPLETELY electrified kitchen and dining room are among the outstanding examples of modern equipment in use by one of the largest mines in Utah. The Park Utah Consolidated Mining Company, located in the Park City mining district, in addition to extensive

Electric ovens and heavy-duty range in kitchen of Park Utah Mining Company

use of electricity in its mining and milling operations, maintains a kitchen equipped throughout for electric cooking.

Electrical equipment in the kitchen includes a 10-gal. coffee urn, one 4-ft. heavy-duty range with 4-ft. cooking top, a heavy-duty service griddle, one two-deck baking and roasting oven and one three-deck baking oven. A hood has been installed over these units and a ventilating fan provided which changes the air in both the kitchen and dining room every three minutes. The total connected load in cooking equipment is 71.8 kw.

With the present cooking installation it is possible to serve three meals a day to 260 men. Power consumption is estimated at 6,000 kw.-hr. a month, with an average saving in cost of from 10 to 15 per cent as compared with coal units.

Letters from Our Readers

More By-Products—A Further Discussion of Cost Allocation

To the Editor of the ELECTRICAL WORLD:

The calf has been exhumed. Once more our young bull has been dragged out and spread on the dissecting board of cost allocation. The latest article appeared in the ELECTRICAL WORLD of Aug. 25 and is entitled "The Complete Peak Method." This method is recommended as an improvement over the schemes of Messrs. Greene, Hills and Eisenmenger. At first glance this seems correct, but that is no reason for approving the method. The proverb makers of the past remind us that the proof of the pudding (even of veal pudding) is in the eating, and while it may be claimed that our subject is past the stage where it can be made into pudding, let us proceed with a test.

In Table I the first column of figures, headed "Capacity Responsibility," is taken from the article describing the "Complete Peak Method." The other columns show the first test.

TABLE I—ANALYSIS OF COMPLETE PEAK METHOD

System	Capacity Responsibility	Demand Cost	Maximum Demand in Kw	Demand Cost per Kw.
A	5,055	$25,275	12,000	$2.11
B	3,366	16,830	4,000	4.21
C	2,000	10,000	4,000	2.50
D	3,822	19,110	8,000	2.39
E	2,000	10,000	2,000	5.00
F	2,757	13,785	4,000	3.45
Total.....	19,000	$95,000	.....	.....

Assuming for convenience a demand cost of $5 per kilowatt of plant demand, we have the allocation of the demand cost, according to this new method, in column 2. The third column of figures shows the individual maximum demands of the various classes and the last column shows the calculated demand cost per kilowatt.

The natural assumption from the final column of this table is that class A load is the most desirable, since it apparently costs the least per kilowatt of demand. Class D is apparently the next desirable, followed successively by classes C, F, B and E. However, a glance at the load curve of Fig. 1, which is here reproduced from the orginal article, would indicate that class A business should be last instead of first, that class C should be first instead of third and that E should be listed in second place instead of last. The order on the basis of the apparent attractiveness of the business is as follows: C, E, F, D, B and A.

If the company were contemplating additional sales of 48,000 kw.-hr., in what form would it prefer this

additional energy—as class A business or as any other of the various classes? Obviously, class A would be the most undesirable type for the additional load, and yet the supposed cost allocation indicates the lowest demand cost per kilowatt for this type of load.

The authors of the new method have apparently either not read the writer's discussion in the ELECTRICAL WORLD* of the phantom peak method of Mr. Hills or they consider it beneath their notice. In that article a number of tests were applied to the Hills method, which tests show equally weird results on the latest scheme. To apply the extreme test of a 100 per cent load factor, let us suppose we were able to obtain a

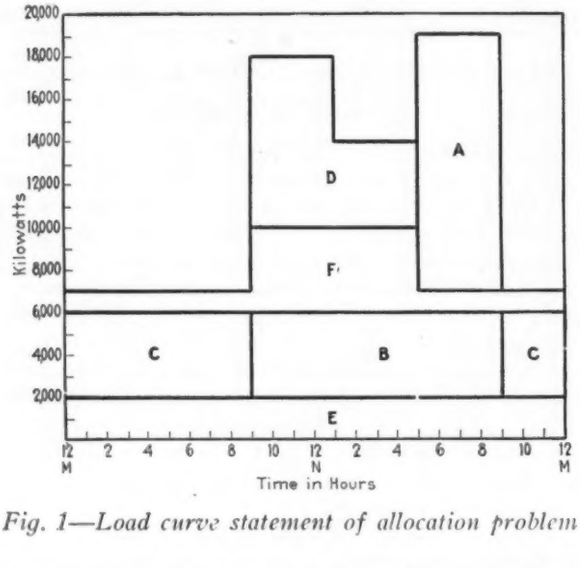


Fig. 1—Load curve statement of allocation problem

heat treatment customer, K, who would agree to so operate his plant as to fill in all of our valleys and give us practically a 100 per cent load factor. All peak demand costs thereupon disappear when an allocation is made according to the complete peak method and we have a division of demand costs according to Table II.

TABLE II—EFFECT OF OBTAINING A 100 PER CENT LOAD FACTOR

System	Capacity Responsibility per C.P. Method	Demand Cost	Maximum Demand Kw.	Demand Cost per Kw.
A	2,000	$10,000	12,000	$0.83
A	2,000	10,000	4,000	2.50
C	2,000	10,000	4,000	2.50
D	2,000	10,000	8,000	1.25
E	2,000	10,000	2,000	5.00
F	2,000	10,000	4,000	2.50
K	7,000	35,000	12,000	2.92
Total.....	19,000	$95,000	.....	.....

The absurdity of the complete peak method becomes apparent when Table II is examined. We find demand costs per kilowatt inversely proportional to load factor. Class A business, with the poorest load factor, is assessed only 83 per cents per kilowatt of demand, while the 100 per cent load factor of class E business is assessed $5 per kilowatt. Similarly, type C business is charged the same per kilowatt as type B and the new customer is given the second heaviest demand cost per kilowatt. The use of a 100 per cent load factor illustration is an extreme test, but extreme tests are useful in disclosing fallacies.

Another practical test might be to show the effect of persuading the customers in class C to double their load by means of attractive rates which carry, in addition to all commodity costs a demand charge of, say, $5,000. This $5,000 would be pure "velvet" to the company. However, after obtaining the business, if we make a new analysis according to the complete peak method we shall find that the demand cost of the type C business has increased from $10,000 to $20,000, so that apparently the company is losing $5,000 on the new business instead of making that much additional profit. The details of this are shown in Table III.

TABLE III—EFFECT OF DOUBLING TYPE C LOAD

System	Capacity Responsibility per C.P. Method	Demand Cost	Maximum Demand Kw.	Demand Cost per Kw.
A	4,500	$22,500	12,000	$1.88
B	2,900	14,500	4,000	3.62
C	4,000	20,000	8,000	2.50
D	3,200	16,000	8,000	2.00
E	2,000	10,000	2,000	5.00
F	2,400	12,000	4,000	3.00
Total.....	19,000	$95,000	.....	.....

It will also be noted from Table III that the doubling of type C business causes no change in the cost per kilowatt of that class of business, but apparently makes it much cheaper to serve types A, B, D and F.

If the new load C is not included as part of the old load C, a wide variation as to the cost of this new load is obtained, dependent upon whether it is classed as type A, B or any of the other types. For example, if the new load is considered as a growth of the present B load, the demand cost chargeable to the combination becomes $20,000, which is an increase of only $3,170 over the demand cost of the original type B. On the other hand, if the new load is considered as a growth of either type C or type E, the new demand cost of the combination is $20,000, or $10,000 more than the original figure. Thus, if we consider the new load as an addition to type C, it costs more than three times as much as if it is considered as an addition to type B. Table IV shows the five different values arrived at for the cost of the new type C load, dependent upon the method of including it.

TABLE IV—DEMAND COST PER C.P. METHOD

System	Original	With Addition of a New Type C		Difference
A	$25,275	AC	$32,000	$6,725
B	16,830	BC	20,000	3,170
C	10,000	CC	20,000	10,000
D	19,110	DC	25,000	5,890
E	10,000	EC	20,000	10,000
F	13,875	FC	20,000	6,125

Judging by these comparisons and by the other tests used in our former article, the "Complete Peak Method" can be classed with those of Hills, Greene and Eisenmenger as unsound, illogical and dangerous.

The true proof of any pudding is not only in the eating but in the after effect. Unless rate makers are extremely careful in applying these theories of cost allocation in actual practice, some of our utility companies are liable to suffer from acute indigestion.

Cost allocations are like rich puddings, which, taken sparingly, taste nice and may not cause any damage. However, when taken in large quantities not only will they cause indigestion but major operations may be necessary.

CHARLES S. REED,
Consulting Engineer.
New York City.

*"*Veal, Hide and By-Products,*" ELECTRICAL WORLD, *Aug. 27, 1927.*

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Condensing Equipment—The principal development in condensing equipment in the past year is stated in this committee report to be the reduction in surface area of condensers for large units whether in single or multiple shells. The limited space available for the condensers, the improved water rates of turbines and the greater number of single-pass units purchased are some of the important factors which have affected this development. No notable developments in condenser auxiliaries have been evident, although an increased number of vertical circulating pumps and three-stage steam-air ejectors are being installed. Operating difficulties with certain types of equipment, installation procedures and recommended designs are discussed in this paper and statements are presented by two companies showing the necessity for and use of wearing tips at the inlet end of the condenser tubes. Improved methods are reported for obtaining a sample of condensed steam before it is contaminated by the circulating water. Statements by the manufacturers of condensers, auxiliary apparatus, condenser tubes and spray pond equipment are included.—*Serial Report National Electric Light Association,* July, 1928.

Station Piping.—In this committee report particular attention has been devoted to bleeder heaters, with special reference to the design and location of the apparatus as it affects the arrangement of piping, and the operation of heaters and appurtenances; the construction and operating performance of reducing valves and de-superheaters, with particular reference to their use in connection with high-pressure, high-temperature steam piping systems, and a study of the various methods in use for the collection, removal and disposal of condensate from high-pressure steam piping systems. Heater data have been tabulated for a number of specific installations and the results compared. The installation characteristics of high-pressure reducing valves have also been noted.—*Serial Report National Electric Light Association,* July, 1928.

Transmission, Substations and Distribution

Constant Full-Load Distribution.—An application of the Wilkinson change-circuit system to hot water storage is described in connection with a discussion of the desirability of securing a hot water heater load for off-peak service. The essential principle of this scheme lies in the use of two independent feeders with one common line, one of the feeders being maintained at constant voltage for the customary lighting, domestic or industrial load, while the other supplies energy at a variable voltage for thermal storage and similar purposes. The voltage on the change-circuit feeder is automatically varied so as to maintain the sum of the loads; that is to say, the total load on the substation, at approximately full load continuously. By filling up the valleys in the load curve the increased cost of production is but little more than the cost of fuel. In operation the normal supply is at constant voltage and serves the ordinary lighting, domestic and industrial load. An induction regulator is designed with a 1:1 ratio and with the rotor and stator windings connected in series, giving a highly efficient unit with a voltage range from zero to double line volts. When the transformer is fully loaded with the ordinary load the voltage across the regulator is zero and no power is supplied to the thermal-storage circuit. When the ordinary load falls to its minimum, the regulator gives maximum electromotive force and the total load on the transformer is maintained constant by the thermal-storage system.—*Electrical Review (England),* July 20, 1923.

Overhead Transmission Lines.—W. J. JOHN.—Sag curves and tabulated values prepared by the author to facilitate the calculation of conductor sags are offered in connection with what is said to be an improved plan for such determinations. A number of specific examples are given following the plan and illustrating the application of this method.—*Electrical Review (England),* July 20, 1928.

Units, Measurements and Instruments

The Measurement of Lagging Temperatures.—As a result of a series of investigations involving the measurement of lagging temperatures there is presented a quantity of data regarding heat losses through several insulating materials under various conditions. Curves indicating percentage of heat loss with various thicknesses of lagging and for various pipe sizes have been prepared. Mathematical expressions for accurate presentation of insulating values are included.—*Engineering (England),* Aug. 3, 1928.

An Amplifier to Adapt the Oscillograph to Low-Current Investigations.—SIGMUND K. WALDOF.—The recognition of the need in several fields of electrical engineering research for a means to study time relations, wave forms, and similar phenomena where only infinitesimal currents are obtainable, has led to this discussion by the author. The limitations and advantages of several possible methods of investigation are compared briefly and the conclusion reached that the ordinary oscillograph can be most profitably adapted to such work. The best form of vacuum tube amplifier for the work is discussed and a description is given of the steps taken in the design of a suitable resistance coupled amplifier. The results of tests showing the quality of reproduction are illustrated in the form of oscillograms and in a characteristic curve. Recommended procedures and precautions desirable in the use of the amplifier are mentioned in connection with the possibilities of the oscillograph for a wide field of use.—*Journal of the American Institute of Electrical Engineers,* August, 1928.

Illumination

Carrier-Current Control of Street-Lighting Circuits.—F. M. SPAUGH and H. E. ALLEN.—A general review of the street lighting systems utilized previous to the advent of carrier-current control has been offered in connection with this discussion of the search for the ideal system for the operation of street lighting circuits. The problem, involving the difficulties of securing the desired results and the methods available for control at the present time are given in connection with an exposition of the carrier-current control equipment utilized in several American cities.—*General Electric Review,* September, 1928.

Electrophysics, Electrochemistry and Batteries

Lightning Arrester Problems.—A. L. ATHERTON.—The present status of lightning arrester applications on transmission lines and the probable trend of future investigation to determine the most effective design and method of application of such equipment are outlined. The value of klydonograph tests is considered, and the results of contemporary tests with such equipment indicate that lightning arresters are needed on both high-voltage and low-voltage lines. Suggestions regarding best practices in both design and application have been made in the interest of better protection and more economical expenditures to secure it.—*Journal of the American Institute of Electrical Engineers,* August, 1928.

Primary Wet Cells.—A. MORTIMER CODD.—A new type of primary wet cell utilizing, through a special arrangement, carbon and zinc electrodes and an electrolyte which is essentially ferric chloride, has been devised by the author. An outline of the several problems involved in producing a satisfactory primary cell, an analytical consideration of the several types available and an exposition of the reasons for producing the cell in question have been given.

The completed cell consists of a glass vessel, at the bottom of which lies a zinc plate roughly shaped to the configuration of the base of the vessel, to which is attached a rubber-covered wire. The mouth of the container is covered with a lid, from which hang one or more carbon plates dipping into the electrolyte. The number of carbon plates or their area may be varied. The electromotive force of such cells is approximately 1.52 volts and the internal resistance of a cell containing 1½ pints of electrolyte about 0.6 ohms. A ferric-chloride solution is first emptied into the cell and this attacks the zinc plates. Zinc chloride is then formed, which, owing to its greater density, lies at the bottom of the cell, thereby protecting the zinc under open circuit conditions. The output curve of any particular cell repeats itself on recharge with remarkable fidelity, so that the output of any cell under similar conditions, may, it is said, be absolutely relied upon.—*Electrical Review (England)*, Aug. 10, 1928.

Heat Applications and Material Handling

Standard Equipment Slightly Modified Interlocks 4½-Mile Conveyor.—F. R. GRANT.—The circuit arrangement by means of which the primary and secondary control panels for a lengthy conveyor installation were interlocked for unit operation are described by the author. The installation was that in a coal mine and the electrical equipment consists of twenty wound-rotor type induction motors varying from 50 to 155 hp., and twenty automatic starting and control equipments. The chief feature of the control is a system of interlocking that insures the proper sequence in starting and adequate protection during running to prevent the delivery of coal to a stopped section. A master control panel is located at the delivery end of the conveyor, and contains the devices for control of the twenty sections. An emergency control circuit is provided with hand operated switch located at each motor station. Opening any of these switches de-energizes the emergency control contactors and the master panel, thus shutting down the entire system. Solenoid brakes have been supplied for all motors.—*Coal Age*, August, 1928.

Making Electric Manganese Steel.—J. H. HRUSKA.—Details of the manufacturing process for the preparation of electric manganese steel have been presented in connection with a statement of the advantages and disadvantages involved. Austenitic manganese steel made in the basic electric furnace is seen by the author as possessing the advantages of homogeneous metal, practically negligible loss of manganese, but little non-metallic and gaseous inclusions, and the possibility of a hotter steel. The disadvantages, when compared with the same material produced through the open-hearth furnace process, have been set forth as follows: Often the steel is finished and tapped too hot, which fact causes the usual higher shinkage of electric steel as compared with the product of open-hearth furnaces; when using tilting ladles, slag interferes very often, thus bottom pour ladles should be considered as standard practice; and higher production cost.—*Iron Age*, Aug. 23, 1928.

Electric Heating by Low-Temperature Surfaces.—H. AMBROSE CARNEY.—It is stated by the author that the most efficient and most generally applicable form of low-temperature equipment for large and small space heating installations is the pipe or tubular type. This equipment consists of wrought iron tubes approximately 2 in. in diameter, with length varying from 2 to 17 ft. The usual load of such tubes is 60 watts per foot run, the surface temperature being then approximately 2,000 deg. F., although varying slightly, according to the nature of the surface. The actual heating element in a properly designed tube is run at a black heat, and long life is thereby assured. Suitable supports are arranged inside the tube which rest on porcelain or mica insulators surrounded by a relatively large air space. The several types of low-temperature heaters are described and the governing factors and their use outlined. Methods of determining the size, length and capacity of heating equipment have been covered, as well as the wiring methods involved in such installations.—*Electrician (England)*, Aug. 31, 1928.

Traction

Power Supply for Railway Signals and Automatic Train Control.—C. F. KING, JR.—A general consideration of the several systems of automatic block signaling, particularly the alternating-current systems, and the apparatus commonly used to insure continuity of power supply. Early phases of the subject have been covered, as have later applications and developments. The modern system of continuous inductive train control has required the development of frequency converting apparatus in connection with its use.—*Journal of the American Institute of Electrical Engineers*, September, 1928.

Telegraphy, Telephony, Radio and Signals

Methods for the Measurement of Radio Field Strengths.—C. R. ENGLUND and H. T. FRIIS.—A review of methods of measuring the field strengths of several types of radio waves, including sinusoidal waves of frequencies below one megacycle, sinusoidal waves of frequencies above one megacycle and telegraphic signals and static. The theoretical consideration and practical limitations involved in the measurements of these quantities have been offered full consideration by the authors and the results which may be justifiably anticipated have been pointed out.—*Reprint B-316, Bell Telephone Laboratories, Inc.*

Miscellaneous

Strain Effects in Mild Steel.—HENRY S. RAWDON.—The present scientific knowledge of strain workings as related to incipient yield and plastic flow is summarized and methods of observing such workings are outlined with notes on the hardening and increase of corrodibility of steel by strain. A thorough investigation of each has been undertaken and among the features considered by the author are: Mechanism of straining, elastic deformation, strain effects accompanying yielding, etching methods, microscopic examination, X-ray examination, cold working, strain lines produced by shock, and miscellaneous strain effects. It is concluded by the author that the effects of the strain upon metals as recorded in the structure have been considered for a mild steel, but that similar effects are discernible in any steel containing a considerable amount of ferrite, that elastic strain produces no change in the micro-structure of a steel, that changes corresponding to yielding under stress may be demonstrated by a number of means, that the stress beyond the yield point produces a progressively greater change in the appearance and the structure of the steel, the effects of impact and shock stress on steel are recorded in the micro-structure in characteristic and definite manner and that the corrodibility may be greatly increased as a result of permanent strain.—*Engineering News-Record*, Aug. 16, 1928.

Tired Steel.—HERBERT F. MOORE.—A clear exposition of the fundamental phenomena of fatigue in metals. The assumptions which must be made in order to secure any results whatever in such an investigation and the fundamental policies involved have been pointed out. Interesting microphotographs illustrative of metallic surfaces under successive applications of stress have been included and a discussion of the influence of the surface, finish and shape of tested material upon the fatigue phenomena have been covered. The author anticipates a better understanding of fatigue failure in the future and points out the errors in present assumptions.—*Engineers and Engineering*, August, 1928.

Stresses and Reactions in Expansion Pipe Bends.—A. M. WAHL.—Methods are outlined for the determination of stresses and reactions in pipe bends, in accordance with exact theory which takes into account pipe cross-section distortion. Formulas for various types of bends are given. The computation of maximum transverse and shearing stresses in accordance with the exact theory is facilitated by means of curves which are included. The theoretical results for deflection and distortion of the pipe cross-section are verified by tests. Application of the theory to practical cases is illustrated, while the effect of steam pressure on the amount of flattening has been investigated.—*Transactions of the American Society of Mechanical Engineers*, May-August, 1928.

News of the Industry

Trade Commission's Scrutiny Resumed

Representatives of the Utility Industry Are Questioned Closely Concerning Letters Written, Reimbursements to Speakers and Investigations Conducted by Them

By Paul Wooton
Washington Correspondent of the Electrical World

LETTERS which according to their writers convey wrong impressions played a part in the opening hearing when the Federal Trade Commission's public utility inquiry was resumed on Sept. 18. It is becoming more and more apparent that Judge Healy, the commission's chief counsel, is building a case on correspondence to show the motive behind activities which otherwise might not be open to criticism. He is trying to establish the motives of the industry in having studies made of plants operating small generators driven by oil-burning engines, in paying the expenses of certain persons invited to address conventions and in supporting studies of such matters as rural electrification and nitrogen fixation.

Commissioner McCulloch, who is presiding, appears to have adopted a new policy governing his own participation in the proceedings. He is departing from his former judicial attitude and in his questioning of witnesses is showing a tendency to assume the rôle of prosecutor. This was particularly marked during the testimony of Paul S. Clapp, managing director of the National Electric Light Association.

The examination of H. E. Weeks, director of the Iowa Section of the National Electric Light Association, took up most of the time at the Tuesday session. It developed that his organization had contributed $15,600 to the Iowa State University since 1925 for carrying on research work on problems connected with rural electrification. Frank D. Paine, in charge of this work at the university, received no compensation but was reimbursed for expenditures.

Oil Engine Investigation

The activities of the Iowa association in having an engineering firm make a mechanical investigation of an oil-engine generator that was being offered to municipalities came in for questioning. The evidence indicated that the utilities had gathered the information merely for their own information, not to discourage municipalities buying the machines.

Particular interest was shown by Judge Healy in a letter from Mr. Weeks to C. S. Macy, president of the Iowa association, in which the advisability of distributing the National Electric Light Association's rate books to the press was discussed. Mr. Weeks counseled against permitting the director of the information bureau, Joe Carmichael, to distribute the rate books, on the ground that it would not be advisable to have Mr. Carmichael's connection with the utilities seem too obvious.

Much evidence was presented by counsel for the commission in the shape of vouchers and expense accounts for the apparent purpose of disclosing contributions emanating from Iowa utility sources and made to school authorities. It was brought out in each instance, however, that these amounts had been appropriated merely to reimburse the educators for expenses in attending meetings in which farm electrification and kindred subjects affecting both the utilities and the schools were taken up.

Various questions by Judge Healy intended to establish that the research work at the university had as its real object the influencing of public opinion against municipal ownership and the establishment of close relationships with the school brought forth positive denial from Mr. Weeks that this was in any sense a part of the plan.

In questioning C. H. Howell of Atlantic City, president of the New Jersey Electric Association and chairman of the New Jersey Public Utility Information Committee, Judge Healy sought to establish the relationship of the New Jersey utilities and the schools. A letter introduced in evidence was sent by A. G. Mackenzie, director of the New Jersey association, to the superintendent of county schools. This letter, it was stated, accompanied a booklet entitled "Our Public Utilities" and offered to send a set of these booklets to each high-school senior. It was brought out that Mr. Howell's organization was preparing other material for school distribution, including literature on electric railways, gas companies, telephone companies and sewage and water works.

Another letter to which counsel for the Federal Trade Commission apparently attached particular significance was one sent by Mr. Howell to George N. Tidd, president American Gas & Electric Company. This letter called attention to the tendency of municipal plants to eliminate power-house worries by purchasing energy at wholesale rates. In the letter Mr. Howell said that he was not sure that it was proper for the utilities to take on a power contract to wholesale energy to municipal plants. He said further that he had issued instructions to keep the demand up to the very highest point so that the power cost would be as high as possible.

Legislative Expenditures

The hearing got under way on Wednesday with the questioning of William H. Roth, secretary of the New Jersey Utilities Association. Asked by Judge Healy as to the method employed by his organization in combating adverse state legislation, Mr. Roth replied that steps were taken in such cases to arrange for public hearings. At these hearings the utility men endeavored to state their side of the case. He said that no outside men or interests were called upon to testify in these cases.

Letters were introduced into the record for the purpose of showing that the New Jersey Utilities Association made a point of leaving out of its records all reference to steps taken to oppose legislation. Mr. Roth said his association had fixed its attitude of not recording legislative matters long before the Federal Trade Commission's investigation. This policy had been adopted, he explained, because there were so many bills that the recording would have been difficult.

A point to which Judge Healy apparently attached importance concerned a resolution adopted by the New Jersey association, which favored the establishment of a course in public utility operation at Rutgers College at New Brunswick, the course "to be of a nature that would be thoroughly satisfactory to this committee."

A. J. Marshall, secretary of the National Electric Light Association, was asked to identify certain disbursements of his organization. His testimony showed that William Allen White was paid $500 by the N.E.L.A. when he addressed its 1926 convention at Atlantic City, that Bruce Barton had his expenses defrayed when he attended a convention held in San Francisco in 1925 to make a similar address, and that two checks of $500 each for the expenses of J. F. Shaughnessy, former president of the National Association of Railroad and Utilities Commissioners, at the Atlantic City convention of 1926 were drawn. Mr. Shaughnessy traveled from Carson City, Nev., to Atlantic City. Others who had their expenses paid to N.E.L.A. conventions, according to the records introduced, included the editor of the Boston *Transcript*, William D. B. Ainey, chairman of the Public Service Commission of Pennsylvania, and George C. Mathews of the Wisconsin Railroad Commission.

Paul S. Clapp, managing director of

the N.E.L.A., was called to the stand to testify on the matter of payment of $5,000 to the Fuel and Power Educational Foundation of Ohio. Mr. Clapp explained that this organization was engaged in research work on nitrogen fixation. Judge Healy asked the witness if he were aware of the fact that Dr. S. S. Wyer, who was directing this research work, had been engaged at the same time in making a survey on Boulder Dam for the Ohio State Chamber of Commerce. Mr. Clapp said he had known of this Boulder Dam activity of Dr. Wyer's only in a general way. Judge Healy then reminded the witness that the N.E.L.A., through George F. Oxley, had distributed copies of Dr. Wyer's Boulder Dam report, which criticised the project.

At this point Commissioner McCulloch asked Mr. Clapp why his organization was interested in the matter of nitrogen fixation. Mr. Clapp replied that the rapid improvement of synthetic chemistry since the Muscle Shoals development was first brought up made essential the establishment of the latest scientific facts on the subject from the standpoint of the public welfare. At this Commissioner McCulloch made the statement that he desired the witness to be more candid. The commissioner observed that he did not see why the N.E.L.A. should be any more interested in aiding the farmer in his fertilizer problems than in solving the problems of submarines or airplanes. To make his position more clear, Mr. Clapp stated that the determination of the power possibilities at Muscle Shoals was contingent upon the fertilizer phase of the situation.

N.E.L.A. Advertising Expense

George F. Oxley was called to the stand to explain the advertising activities of the N.E.L.A. The appropriations for this work have amounted to $100,000 a year for the last few years, he said, and have been handled by the Lord, Thomas & Logan Advertising Agency. It was brought out that part of this appropriation was used to pay for the preparation of news articles in rural magazines on utility matters. The amount used for such purposes amounted to $8,500 a year, he testified. It was also brought out that Mrs. John D. Sherman, president of the General Federation of Women's Clubs, was paid $600 for one of these articles. Mr. Oxley testified that no payments were made to papers or magazines for the printing of this material.

An item of $646.46 that appeared in the record books, and which covered the purchase price of 49,500 copies of a speech by Herbert Hoover, was made a part of the record. This was a speech delivered by Mr. Hoover before the National Association of Railroad and Utilities Commissioners, at Washington in October, 1925, entitled "Why the Public Interest Requires State Rather than Federal Regulation." Mr. Oxley said that he thought this speech so good that he desired to distribute copies among the member companies.

Progress in Illumination Recorded

Toronto Convention of Illuminating Engineering Society, Augmented by International Delegates, Deliberates on How to Keep Pace with Advances in the Art

TWO trends in illuminating engineering practice stood out at the twenty-second annual convention of the Illuminating Engineering Society, held in Toronto on Sept. 17 to 20 with a large attendance, augmented by the foreign delegates to the International Illumination Congress to be held at Lake Saranac, N. Y., next week. The first of these trends embodies a new conception for the design of lighting schemes for commercial, public and domestic lighting. This movement had its origin at the Exposition des Arts Décoratifs in Paris in 1925 and is spreading so rapidly that it constitutes a distinct development in the art of interior lighting. France and Germany have set the pace, but the United States is also feeling the impulse. Two features of the new style are that many of the fittings are made of frosted glass in flat sheets and that rooms are lighted largely, not by fixtures, but by built-in units of light that form an integral part of the design and architecture of the room. High illumination with low surface brightness, combined with harmonious decorative design, characterizes this new or modernistic lighting trend. Illuminating schemes become a part of architecture and architectural design must be concurrent with illumination design.

The second trend is involved in the desire to get better conceptions of lighting into practice. Schools, examples of installation, advertising, booklets and all possible outlets were suggested as means to this end. The art of illumination is held to be far ahead of existing installations, and speakers at the convention urged the I.E.S. to take most active steps to correct the bad lighting conditions that prevail.

Recent progress in lighting was recorded in the excellent group of papers listed in the Electrical World for Aug. 25 (page 377). The better lighting of public halls and auditoriums, now in the main poorly equipped, was warmly advocated. Decorative lighting of gardens, brooks, fountains, and other beauty spots, as well as of buildings, was described by A. L. Powell as an esthetic possibility within economic reach of many. Advances in airplane lighting were recorded; a new 10-watt lamp with an intermediate screw base was described, and in contrast there was an account of a 50-kw. lamp with improved methods of radiating the heat it generates; neon lighting was surveyed and shown to have become well standardized as a manufactured device; ultraviolet light for therapeutic work was shown to be growing in use, and street lighting, traffic lighting and lighting as a part of radio development were interestingly discussed. In industrial illumination, it was made clear, the tendency is to use both local and general lighting to get the best results, and installations of good industrial lighting are increasing rapidly.

In his report for the committee on progress F. E. Cady gave some valuable statistics on lighting. The world consumption of incandescent lamps, he said, is more than 600,000,000 a year. European factories produce 200,000,000 and the United States 305,000,000. Tungsten miniature lamps produced amount to 205,000,000, carbon miniature lamps to 14.500,000. For large lamps the average watts and lumens per watt decreased slightly in 1927 as compared with the values prevailing in 1926. The committee estimated that the average home requires seven lamp renewals each year, which would account for a consumption of 123,000,000 lamps a year. For each million new homes built at least 22,000,000 lamps are installed.

In his presidential address Norman Macbeth reviewed the work of the society. He said that the organization could be more useful in the commercial lighting field if it had the money to publish bulletins, codes and load-building matter. He pointed to the great work the society has done in the past, but said its resources were now inadequate to do the things for illumination that appeared needed in view of the widespread modern developments.

Mr. Paterson's Address

A feature of the meeting was an address by Clifford C. Paterson of England, president of the International Illumination Congress. He traced the development of lighting and lighting equipment with the aid of museum material. He said that light could be used or abused; it could soothe or irritate, and he went on to develop the mechanism of lighting and seeing in graphic form. The theory of light still baffles science, Mr. Paterson observed, and new discoveries make old theories obsolete. None the less, illuminating engineers know how to apply light as never before.

Good lighting, according to Mr. Paterson, is something akin to the perfect human character—"that which permeates all around it with charm and helpfulness, but effaces its own individuality." But, he said, despite great progress, the goal is yet far in the distance. In factories, in street lighting, in every application, knowledge is ahead of practice, while the knowledge itself is meager as compared with what the future holds. Mr. Paterson urged international accord and the comparison of experiences in lighting in order to make faster and more orderly progress.

A splendid meeting at the University of Toronto on Monday night was addressed by Premier G. H. Ferguson of Ontario, Dr. Clayton H. Sharp and Mr. Paterson, after which a reception and dance at Hart House was held.

Florida's Transmission Lines Suffer in Storm

West Indian Hurricane Hits East Coast and Passes up Through State, but Power Plants Escape with Little Damage Reported

ONCE more electric light and power systems in Florida have had to bear the brunt of a hurricane of great severity which, originating in the West Indies, where it wrought havoc in Porto Rico and other islands, struck the east coast of the peninsula early this week, took many lives and destroyed much property in West Palm Beach, Palm Beach and other places, caused Lake Okeechobee to overflow, and then passed north through the center of the state and along the Georgia and Carolina coasts, its fury gradually diminishing. It is too soon for any accurate account of the damage done to utility systems. Fortunately this seems to have been much less than might have been the case had the storm taken a different path and struck some of the more populous cities. A correspondent of the ELECTRICAL WORLD at Jacksonville summarizes the situation as follows:

"Scarcely any damage was done by the storm to the municipal power plant at Jacksonville. A few poles went down in the outskirts, but service was 75 per cent restored by Monday night and entirely so on Tuesday. Little or no damage down the state to the power plants themselves is reported, but the distribution lines are in bad shape on the east coast. Joe Gill, general manager Florida Power & Light Company, is quoted as saying that he was bringing in hundreds of repairmen from the Carolinas to restore the lines in the shortest possible time. The greatest damage to transmission and distribution systems was in the neighborhood of Palm Beach and West Palm Beach, served by the Florida Power & Light Company. Miami, where this company has its largest generating station, a city which was hard hit in the hurricane of 1926, escaped the fury of the storm.

"In the south central section of the state also, around Sebring and Lake Wales, transmission systems suffered damage. At Lake Wales a standpipe fell on the power plant of the Florida Public Service Company, damaging the building to some extent. Not much destruction to lines on the west coast is reported. Tampa and its vicinity were out of the storm's path."

Porto Rico Service Is Partly Restored by Strong Effort

The tropical hurricane that had its birth ten days ago in the West Indies struck Porto Rico with particular vigor, taking hundreds of lives and destroying millions of dollars' worth of property. The city of San Juan and the northern end of the island suffered most. Inevitably the Porto Rico Railway, Light & Power Company, which serves that territory, was hard hit. Frederick Krug, its manager, is quoted in the press dispatches as saying that the loss to his company would be at least $3,000,000. In response to a message from the ELECTRICAL WORLD the following radiogram from Mr. Krug was received on Thursday morning, showing the vigorous efforts of the company to surmount the disaster:

"Power service for the restoration of water supply was re-established 45 hours after the storm struck San Juan. Lighting was restored in the business district in 72 hours. Energy for all essential services is being supplied as rapidly as possible. The government plants at Carite are out of service. The plants at Ponce and Mayaguez [on the south and west coasts respectively] are undamaged. The wind at San Juan was 150 miles an hour and on parts of our system probably 200 miles."

The Porto Rico Railway, Light & Power Company, controlled by Canadian interests, has both a steam and a hydro plant, the former being rated at 10,000 kva. and the latter at 10,600 hp. It plans, under legislative authority, to develop another 10,000 hp. of hydroelectricity and has an application pending before the Federal Power Commission.

Many Topics Are Covered at Glenwood Springs

Rocky Mountain Men Want Information Committee Work to Go on Under Guidance of Outstanding Leaders in the Industry

THE twenty-fifth annual convention of the Colorado Utilities Association and the ninth annual convention of the Rocky Mountain Division of the National Electric Light Association came to a close at Glenwood Springs on Thursday, Sept. 20. With 230 delegates registered, the joint conference got under way on Monday with Presidents H. S. Robertson of the Utilities Association and C. N. Stannard of the Rocky Mountain Division serving as co-chairmen. So complete was the program that scarcely a phase of utility business was overlooked. Special emphasis was given public speaking, information committee work, load building and public relations.

President Arkwright told of the recent activities and the ambitious program of the national association, which was also represented by Isabell Davie and Eloise Davison of its women's committee. With respect to information committee work, it was seen that there is no thought of discontinuing committee activity, but rather that the bigger utility executives must take active leadership in committee activity in the future.

Officers to serve on the executive committees of the two associations were elected on Thursday. For the Rocky Mountain Division, N.E.L.A., these are: President, W. D. Johnston; vice-presidents, J. A. Clay, J. E. Loiseau and W. W. Nielsen. A. C. Cornell and O. A. Weller succeed themselves as treasurer and secretary respectively The Colorado Utilities Association elected V. L. Board president and Ray Morris, R. W. Booze and W. N. Clark vice-presidents.

Great Lakes N.E.L.A. Issues Convention Program

Below is the business program adopted by the Great Lakes Division, N.E.L.A., for its eighth annual convention, to be held on Thursday to Saturday of next week at French Lick, Ind.:

THURSDAY, SEPT. 27

Morning—President's address, J. E. Johnson; "Service—the Slogan of Success," Mrs. A. S. Richardson; address, Paul S. Clapp; address, J. F. Owens.

Afternoon—Meeting of women representatives.

FRIDAY, SEPT. 28

Morning—"The Power Company in the Marketplace," C. E. Greenwood; "Possibilities of Increasing Lighting Sales," J. Paul Clayton; "Great Lakes Division Lamp Campaign," E. L. Hinchcliff; "More Kilowatt-Hours Through Group Teamwork," Marshall E. Sampsell; "Results Achieved on Michigan Experimental Farm Line," Prof. J. F. Gallagher.

Evening—Banquet; address by President Arkwright of the N.E.L.A.

SATURDAY, SEPT. 29

Morning—"Is Future System Planning Justified?" E. A. Hester; "Accounting and Management," Arthur Perrow; "The Engineer and His Function," H. B. Brydon; "The Higher Audit," Dempster MacMurphy; "Executive Responsibility for Accidents," K. R. MacKinnon.

National Fuels Conference at Cleveland Has Wide Range

Pulverized-fuel firing received much attention and a wide range of coal-combustion problems were discussed at the four-day national fuels meeting held at Cleveland by the Fuels Division of the American Society of Mechanical Engineers on Monday to Thursday inclusive of this week. Coal producers were advised to unite in research work designed to widen the field for the utilization of their product. Owing to pressure on the news columns the ELECTRICAL WORLD's report of this meeting is unavoidably held over until next week.

Rate Reductions Announced by California-Oregon Company

Rate reductions representing an annual saving of approximately $90,000 to domestic and commercial lighting customers of the California-Oregon Power Company will become effective Oct. 1, according to an announcement by P. O. Crawford, vice-president and general manager of the company. Under the new schedules the domestic lighting rates in both California and Oregon communities will be for the first 50 kw.-hr. per month 8 cents a kilowatt-hour, with the excess at 5 cents, the monthly minimum bill being $1. This represents a considerable reduction under the old schedules, where the top rate has been 10 cents or higher.

N.E.L.A. Committees Meet in Chicago

Budget Approved and Plans Made for Coming Year—Utility Investigation Viewed as Important but Without Alarm—Sampsell Elected a Vice-President

ALLOWANCE and approval of the budget for the ensuing year was the chief business before the meeting of the executive committee of the National Electric Light Association in Chicago on Sept. 13. This meeting concluded a series of committee gatherings that began on Sept. 10. The first meetings were those of the women's and rural electric service committees, followed the next day by sessions of the committees on public speaking, relations with financial institutions and customer ownership. On the third day came the session of the executive committee, Public Relations National Section, and on the fourth, as just stated, the national executive committee met. The last-named meeting afforded little indication that light and power company officials view the Federal Trade Commission utility investigation with alarm, though, on the other hand, there was evident no disposition to minimize its importance.

The growing importance and scope of the work of the geographic sections was emphasized by Paul S. Clapp in his address as managing director and in the reports of the presidents of the sections. Mr. Clapp announced that Ernest Greenwood, author of "Aladdin, U.S.A.," was now a member of the N.E.L.A. headquarters staff and was charged with the duty of carrying to public understanding the information on the central-station industry contained in the statistical compilations of the association. Adverting to the Federal Trade Commission investigation, Mr. Clapp emphasized the *ex parte* nature of the inquiry and the series of selective processes, the picking out of items and their consideration independent of their contexts, through which the evidence had to pass before it reached the commission and the public. He said that he had found in his travels about the country a general condition of good local public relations, with the national situation, as represented by newspaper reports of the commission hearings, not greatly affecting them. The alleged insidious propaganda in the schools was, in one case at least, shown by Mr. Clapp to stand on very little ground. He cited a list of sources from which information on various industries and businesses was furnished to the schools of Cleveland. Of 2,500 different pamphlets, brochures and other literature, only three came from the electric utility industry.

One of the first actions of the committee after it convened was the election of Marshall E. Sampsell as fourth vice-president to fill the vacancy caused by the non-acceptance of that office by Arthur W. Thompson. Mr. Sempsell, who is chairman of the Commercial National Section, outlined the new organization of the section into four bureaus, as already reported in the ELECTRICAL WORLD. He transmitted to the association an offer of a prize award of $1,000 and a gold medal to be given by the Federal Electric Company to the man and the company making the greatest improvement in electrical advertising during the year. The committee voted to accept this offer. Reports on the accomplishments and the work in hand of the Engineering, Public Relations and Accounting Sections were presented by Messrs. E. C. Stone, J. F. Owens and J. F. Ford.

Following these came reports of the national committees on civic development, rural service and advertising. E. W. Goldschmidt, chairman of the exhibition committee, announced the tentative plans for the exhibition at the 1929 national convention in the new municipal auditorium at Atlantic City, June 3 to 7. C. L. Collens, vice-president of the National Electrical Manufacturers' Association, made a plea for a closer co-operation between that body and the N.E.L.A. in the matter of uniform ordinances to regulate electrical uses and applications. Mr. Collens said that fact finding on specific situations was well along and that the time had come for concerted action by the whole electrical industry to the end that production and application of electrical devices and equipment might not be hampered by the unnecessarily diversified requirements of the laws of different cities and states. He moved that the N.E.L.A. appoint a committee to cooperate with the N.E.M.A. and the Society for Electrical Development in the furtherance of this work. The motion was adopted, and President Arkwright appointed Messrs. Davidson, Lloyd, Day, Sampsell and Stone to serve on the committee.

General Electric Broadcasts Drama by Television

Drama by radio has been made possible by recent development of a simplified and portable television transmitter or camera by Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Company and chief consulting engineer of the Radio Corporation of America. The first play by television was broadcast on the afternoon of Sept. 11 during the regular television period of the General Electric Company's Schenectady station, WGY, and a second performance was put on the air at 11:30 o'clock that night. The play was "The Queen's Messenger," a one-act drama by J. Hartley Manners. The television version was the same in every respect as the stage offering, but many new problems in dramatic technique were presented in putting on the air a performance intended for reproduction instantaneously in homes distant from the scene of the action. About 40 minutes was required for the program. Only the heads of the actors can be transmitted at the present stage of the development.

The cameras, of which three were used—one for each of the two characters in the drama and a third for the introduction of "props" and other visual effects—each consisted of three units, a cabinet containing a 24-hole disk and a 1,000-watt lamp as a light source and two smaller cabinets each housing a photo-electric tube with amplifier. There was a microphone for each actor. The performance went out on three wave lengths, the picture being transmitted on two and the voices on one.

Speakers Selected for Safety Congress at New York

The complete program of the seventeenth annual congress of the National Saftey Council, to be held at the Waldorf-Astoria and Pennsylvania Hotels, New York, in the first week of October, embraces more than a hundred meetings—general sessions, industrial and trade sections, other special groups and entertainment features, in addition to the public safety, education and women's session programs.

The National Safety Council aims to be "a clearing house of knowledge and inspiration on accident prevention." It is a voluntary co-operative society with 4,600 members, including public utilities, industries, insurance carriers, public institutions and individuals.

On Monday afternoon, Oct. 1, the New York congress will open with four addresses to be made at a joint session in the Waldorf-Astoria. One of these will be by John W. Lieb, vice-president New York Edison Company, on the contribution of the electric light and power industry to the safety movement.

The first public utilities session will be held on the following morning at the Pennsylvania Hotel, following a breakfast conference. Dr. Samuel W. Grafflin of the Y.M.C.A. is to speak on "First Principles." Dr. James S. Thomas, University of Alabama, will dwell on "The Safety Man's Place in a Public Utility," and the election of officers will take place. On Wednesday morning there will be brief presentations of the past year's work and a distribution of reports and addresses. A joint luncheon with the Electric Railway Section will be held at noon, when there will be a presentation of trophies to the winners in the utilities' safety contest and an address by Ernest W. Beck, vice-president of the National Safety Council. On Thursday morning H. B. Harmer, Philadelphia Electric Company, will speak and there will be a discussion of pole accidents. An informal discussion of accident prevention work in the utilities field will follow, and George Opp, Detroit Edison Company, will ask "What Are We Going to Do About It?"

Purchases and Mergers

West Penn Power Takes Over Dunbar (Pa.) Property—"One-Man" Vermont System Goes to Foshay—Illinois City Plants Consider Offers

THE Dunbar Electric Company and the Dunbar Electric Corporation have made application to the Pennsylvania Public Service Commission for approval of the sale of the property and franchises of the former company in Fayette County to the latter. An application was filed at the same time for approval of the sale of the property and franchises of the Dunbar Electric Corporation to the West Penn Power Corporation.

Announcement, referred to under "Financial and Statisical" (page 590), is made of a plan to merge the Penn-Ohio Securities Corporation and the Northern Ohio Power Company with the Penn-Ohio Edison Company, controlled by the Allied Power & Light Corporation, as a measure to simplify the corporate structure of this public utility group. At the present time the Penn-Ohio Edison is controlled by the Penn-Ohio Securities, and in turn the Edison company controls the Northern Ohio Power Company.

A small utility system owned by one man and widely known in Vermont, the E. M. Nichols Electric Company of Barton, in that state, has been purchased by the W. B. Foshay Company for the Public Utilities Consolidated Corporation, holding company. It will be operated by the Public Utilities Vermont Corporation. The Nichols system was begun nearly 25 years ago by a Glover citizen who "signed up" 30 neighbors and built a three-mile transmission line to the municipal plant at Barton. Twenty years ago Dr. E. M. Nichols of Barton bought the transmission line for $2,800, and he developed the system to a point where, with 113 miles of wire and 600 customers, it brought $120,000 from the W. B. Foshay Company.

The Lake Superior District Power Company has acquired electric systems serving the towns of Park Falls, Fifield and Phillips, Wis. They were formerly served by the Flambeau Public Service Company of Park Falls, Wis. The purchasing company's 66,000-volt transmission line runs through Park Falls and will connect with the 33,000-volt transmission line that serves the three towns.

The Princeton (Ill.) City Council, which is about to authorize a new unit in its municipal light and power plant, is considering an offer from the Illinois Power & Light Corporation to lease the plant for a five-year period at an annual rental of $50,000. The company officials say they can make a rate lower than the city can offer even with a new unit.

The Shelbyville (Ill.) City Council expects to conclude a contract with the Central Illinois Public Service Company by which the utility will connect its power lines with the municipal distribution system and take over the light and power privileges within the city.

The Northern Power & Light Company recently purchased the Pollock (S. D.) Light & Power Company and will take possession Oct. 1. The Otter Tail Power Company has bought from the Dakota Public Service Company electric properties at Starkweather, Tower City and Buffalo, N. D. The Hughes Electric Company, Bismarck, N. D., has purchased the electric plant at Stanton, N D..

The New York Power & Light Corporation has petitioned the Public Service Commission for consent to absorb the Fort Henry Light, Heat & Power Company, supplying Port Henry, Moriah and Crown Point.

A joint petition of the Antwerp (N. Y.) Light & Power Company and the Theresa (N. Y.) Hydro-Electric Power Company and Theresa Electric Light Company for transfer of the Theresa properties to the Antwerp company has been submitted to the New York Public Service Commission.

The Stanley Power Company of Estes Park, Colo., has been purchased by the Public Service Company of Colorado, and the town will be connected with that company's lines. Voters of Peetz, Colo., also, at a special election held Sept. 8, agreed to sell its municipally owned electric plant to the Public Service Company.

The South Georgia Power Company has purchased the city light plant of Abbeville, Ga., and extended its high-tension line into that city.

Taxpayers of St. Francisville, La., at a special election voted to sell the municipal electric light and water plant to the Mississippi Utilities Company for a cash consideration of $40,000.

Plans for Delray No. 3

Detroit Edison Power House Now Under Construction Will Have Initial Equipment of 100,000 Kw. and Ultimate Rating of Three Times That

ALTHOUGH it will be a year before the Detroit Edison Company's Delray power house No. 3 will be ready for service, the framework for the initial half of the ultimate building is well advanced. This portion will accommodate three main generating units and six boilers. The capacity to be installed under the present program is 100,000 kw. The ultimate capacity is to be 300,000 kw. or perhaps 350,000 kw. The outstanding difference between this plant and the Trenton Channel plant is in the fuel-burning equipment. Stokers will be used instead of pulverized-fuel equipment.

Two turbo-generators, each rated at 50,000 kw., will be installed in the near future. These machines will be essentially duplicates of those now installed at Trenton Channel, and complete interchangeability of removable parts will therefore be possible. A noteworthy difference between the Trenton Channel and Delray machines is that steam for feed-water heating will be extracted from four stages at Delray as against three at Trenton Channel.

Two direct-current auxiliary generating sets are to be provided at present, each having a rating of 4,000 kw. and able to carry 6,000 kw. for one hour in emergency without injury by overheating.

Five boilers will be installed at the present time, leaving the No. 1 position vacant temporarily. The type W Stirling boiler, which has long been the standard in Detroit Edison Company power-house practice, has given way to a new design of bent-tube boiler, somewhat of the Stirling character. This new boiler unit is single-ended and comprises in reality two distinct boilers. The upper or main boiler will have three upper drums and one lower or mud drum. Pressure will be higher than 400 lb. per square inch by an amount sufficient to permit superheated steam to be supplied at the superheater outlet at approximately 400 lb. per square inch. The superheated steam temperature will be the same as at Trenton Channel—700 deg. F. The stokers will be single-ended.

Operating simplicity, says P. W. Thompson, chief assistant engineer of power plants, in the *Synchroscope*, a company publication, is the keynote of the design of this plant, and this, together with the fundamental principle of standardization and duplication of equipment, is expected to produce a plant giving not only good commercial efficiency but excellent reliability with a minimum of operating supervision.

Skagit and Sultan River Projects at Seattle

Seattle's municipal authorities are planning to start construction on the Skagit transmission line from Gorge Creek to Seattle about the first of next year. The line will be 120 miles long, three-phase, and carry 165,000 volts. The completed cost, including right-of-way, clearing, pole line and equipment, is put at $1,800,000.

With the power and water potentialities of Sultan River as the prize, a fight between Seattle and the Stone & Webster interests is thought to loom following the discovery that the power company has been making surveys of the Sultan River basin. Stone & Webster declare they have been conducting a survey of the site for more than a year, long before the city "discovered" that this was the logical site for a future water supply for the district between Seattle and Everett. It has been proposed that the city of Seattle co-operate with Everett in development of the Sultan River water source.

Cutting Rates in Kansas

State Commission's Efforts Have Brought Saving of $500,000 to Customers, According to Commissioner Dalton—Five Large Companies Announce Reductions

WHEN two resignations from the Kansas Public Service Commission were accepted by the Governor a year ago, Judge A. M. Pickler succeeding L. T. Hussey as chairman and J. H. Crawford succeeding Frank O'Brien, it was announced that there would be a general survey of the rates of public utilities in the state. W. B. Dalton, one of the three other members, has just given out a statement of what has been accomplished as he sees it. According to his estimate, based on previous consumption, customers will save $500,000 annually. Cities served by all the larger power companies are now enjoying lower rates, with the exception of Wichita, where the schedule of the Kansas Gas & Electric Company was held

to be so low and reasonable as compared with the other companies throughout the state that it was not asked to make reductions. It was the Kansas Gas & Electric Company's rates, as a matter of fact, that caused the general survey to be made.

The Kansas Electric Power Company of Lawrence was the first to file a new schedule, reducing the rates from 10 to 20 per cent and placing all its towns on substantially the same basis, proportional to population. The Kansas Utilities Company of Fort Scott was the next large contributor. Then came the Kansas Power Company of Topeka, followed by the Kansas Power & Light Company of the same city for a part of its system and by the United Power & Light Company of Abilene for a part of its system. Now the Kansas Power & Light has "come through" for most of its other towns. The United Power & Light Company had not yet announced its full new schedule, affecting 80 places, but at the time Mr. Dalton's statement was made had promised the commission to complete it within the next few days.

Reductions have not been uniform, because the rate schedules were of many kinds and degrees. But Mr. Dalton believes that on the whole the reductions have averaged close to 20 per cent, or will when the United Power & Light schedules are included.

Edison Opens Radio Fair in New York City

The annual Radio World's Fair in New York City was formally opened on Monday night when Thomas A. Edison spoke into the microphone at the new Madison Square Garden, where it was held. Introduced by Henry Ford, Mr. Edison made the longest speech of his life. It was as follows:

"Friends of the radio, this is Thomas A. Edison speaking. I have been asked to come here tonight to formally open this fair. Please do not expect a speech from me, as public speaking is entirely out of my line. So I will do what has been requested of me and now declare this Radio World's Fair as formally opened."

Mr. Ford had said: "It is proper to remember on this occasion that radio, like all other industries, is in debt to Mr. Edison's great mind. More than fifty years ago he discovered the principle of wireless communication, and he invented the carbon telephone transmitter, which is substantially the radio microphone of today. More than forty years ago he discovered and applied the Edison effect, which is the foundation principle of radio tubes; and it is just forty years ago this year that Mr. Edison first experimented in wireless communication between moving railway trains."

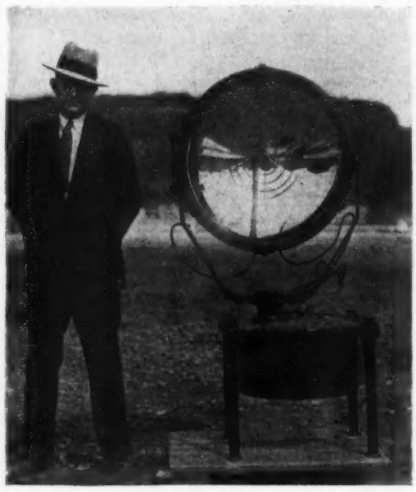
The exhibition, which was on the usual elaborate scale, has evidenced clearly the growing demand for alternate-current receiving sets among radio amateurs.

Briefer News

ROCHESTER COMPANY CHANGES NAME.—The Rochester (N. Y.) Empire Power Corporation has filed a certificate in the office of the Secretary of State at Albany changing its corporate name to Rochester Central Power Corporation.

EMMETSBURG, IOWA, TO GET ITS MUNICIPAL PLANT.—The Iowa Public Service Company has been denied an injunction to restrain the Municipal Utilities Company of Des Moines from continuing with the building of the Emmetsburg (Iowa) municipal power and light plant. Work upon the plant has been started.

BINGHAMTON UTILITY COMPANY AIDS AVIATION.—The Binghamton (N. Y.) Light, Heat & Power Company is pioneering in the installation of beacons to direct aviators flying over that part of New York State. To this end it has just installed two powerful beacons on the roof of its substation building



and painted the name of the city on the service building roof on Noyes Island. The beacons have a total capacity of 16,000,000 cp., and they will be turned on every night. The beams are said to be visible at a distance of 50 miles on a clear night.

CHARLES CITY, IOWA, TO HAVE AN IMPROVED GENERATING PLANT.—The Iowa Public Service Company has improved its Charles City generating plant by erecting a 179-ft. smokestack and is preparing to install a new turbine. When the plant is completed it will be the largest in northeastern Iowa.

HYDRO DEVELOPMENT ON THE KENNEBEC AND THE HOUSATONIC.—The Central Maine Power Company has started construction of its coming 40,000-hp. hydro-electric plant above Bingham, Me., on the Kennebec River. This development, as previously reported, includes a 100-ft. dam and will involve an expenditure of $7,000,000. ——The Connecticut Light & Power Company has tentative plans for further power developments on the Housatonic River. It is possible that four more hydro-electric plants will be built along the river, following the completion in the near future of the company's 33,000-hp. Rocky River plant. This would give it seven hydro plants and one steam plant along the Housatonic.

WORK ON ONEIDA-CORTLAND (N. Y.) 110-KV. LINE ABOUT TO BEGIN.—Construction of the 110-kv. transmission line from Oneida to Cortland, N. Y., will be started within two or three weeks, according to S. O. Wilson, local manager of the New York Power & Light Corporation at Oneida. Right-of-way has been obtained. The line will be built over Peterboro Hill, taking a direct course between the two cities, which are about 50 miles apart. Construction work will be carried on from both.

METALLURGICAL PLANT PLANNED FOR SERVICE FROM NEW RIVER (W. VA.) PROPOSED DEVELOPMENT.—Power generated at two dams which the New-Kanawha Power Company desires to erect in New River, near Hawk's Nest, at a cost of approximately $9,000,000, will be used by a metallurgical plant to be constructed at Boncar, W. Va., according to Leonard H. Davis of the Union Carbide & Carbon Corporation, who testified before the Public Service Commission of West Virginia in a hearing for permission to build the dams. Following the testimony of Mr. Davis, the commission announced the employment of Charles E. Krebs, a Charleston geologist, to investigate the water-power project and adjourned the hearing.

ALABAMA POWER COMPANY VALUATION PROCEEDINGS BEGIN.—Valuation of the properties of the Alabama Power Company was begun by the Alabama Public Service Commission last week. For more than two years engineers of the commission have been inspecting records of the company and gathering information. The valuation to be established will represent all properties acquired by the power company since June 30, 1920, when the commission reached a valuation of $29,000,000. Since 1920 the power company has constructed the installations at Mitchell Dam and Martin Dam, and it is now contemplating the construction of another unit at Jordan Dam. Reports submitted to stockholders Dec. 31 last indicated that the company had placed a book value of about $150,000,000 on its holdings in Alabama.

RAPID GROWTH OF PLANT IN TEXAS PANHANDLE.—The recent completion of a second unit in the plant of the Southwestern Public Service Company at Amarillo, Tex., in the Panhandle district, brings its capacity to 15,000 kw., which may eventually be doubled. The company, in the two years following a change in ownership, has spent more than $4,000,000 in equipment, and it now has, according to the man-

ager, as quoted, 152 employees and 12,709 customers. The company now has under construction a transmission line from Panhandle to Claude and will also have completed within a few months a connecting line from Amarillo to Canyon, by which service can be supplied to a number of towns in the South Plains over the lines of the Texas Utility Company.

NEW YORK EDISON COMPANY OPENS AUTOMATIC SUBSTATION AT SPUYTEN DUYVIL.—One of the largest automatic substations yet put into operation was opened on Sept. 17 at 238th Street and Spuyten Duyvil Road, New York, by the New York Edison Company. The new station is a one-story brick structure, 125 ft. by 85 ft. in dimensions. It receives current at 13,200 volts and distributes it at 2,300 volts. Operation is from a station three miles away. The control system used is that of the Westinghouse Electric & Manufacturing Company adapted by the New York Edison Company's engineers.

DETROIT TO HAVE TWELVE-STORY SIGN.—Detroit will soon boast an electric sign twelve stories high which will be visible over almost the entire city and to aviators several miles distant. It will be 150 ft. in height and 12 ft. across, the main girders having been especially projected so that the sign may be built permanently on to the steel structure. Nearly one-half mile of argon tubes make up the electric display, which is one of three major installations that Rainbow Light, Inc., is constructing for the Fox Theater. Because of the size of the sign it is being made in sections, divided between the Detroit plant of the company and the main plant at Long Island City, N. Y.

PROGRESS OF PUBLIC SERVICE COMPANY'S METUCHEN (N. J.) SWITCHING STATION.—Work on the new Metuchen switching station of the Central Division of the Public Service Electric & Gas Company of New Jersey is well under way, that company reports. The new switching station will be able, by means of a double-circuit tower line to the Roseland switching station, also under construction, to receive and distribute electricity not only from Public Service power stations but also from stations in Pennsylvania of the Pennsylvania Power & Light Company and the Philadelphia Electric Company. The Metuchen station will be similar in design to other switching stations of Public Service and will have a capacity equivalent to about 75,000 kw. Present construction is only for the first half of the station. A control and synchronous condenser house, a section of the latter to be used as a transformer repair house, is to be part of the station. The necessary bus structure and equipment to feed the synchronous condenser will be installed in a small outdoor substation which will receive its power from the main transformer bank. The transmission lines now tied into the Durham Avenue substation, Metuchen, will be extended to the new switching station, which will replace the old one.

FIRST FLYING ELECTRIC SIGN.—An up-to-date method of advertising had its first exemplification in New York last week when an airplane circled around uptown Manhattan at an altitude of 2,000 ft. carrying an electric sign composed of eighteen letters 6 ft. high and bright red in color. The name and address of the promoter of the advertising plan, Aerial Advertising, were flashed on and off. The sign covered the plane's entire wing span of 90 ft. and was illuminated by high-voltage current passing through tubes of neon gas. One set of letters was superimposed upon the other to permit change of wording. The power was generated by motors rated at 7,000 volts and occupying most of the plane's cabin space.

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see issue for July 7, page 48.]

American Electric Railway Association—Cleveland, Sept. 22-28. J. W. Welsh, 292 Madison Avenue, New York.

International Committee on Illumination, Saranac Inn, Lake Saranac, N. Y.—Sept. 22-28.

New England Section, N.E.L.A.—Poland Springs House, South Poland Springs, Me., Sept. 24-27. Miss O. A. Bursiel, Statler Bldg., Boston.

Great Lakes Section, N.E.L.A.—French Lick Springs, Ind., Sept. 27-29. R. V. Prather, 205 Illinois Mine Workers' Bldg., Springfield, Ill.

American Society of Mechanical Engineers—Boston, Oct. 1-3. C. W. Rice, 29 West 39th St., New York.

Association of Edison Illuminating Companies—Chamberlin-Vanderbilt Hotel, Old Point Comfort, Va., Oct. 1 to 5. P. S. Millar, East End Ave. and 80th St., New York.

National Safety Council—Hotel Pennsylvania, New York, Oct. 2-5. W. H. Cameron, 108 East Ohio Street, Chicago.

Southern Appalachian Power Conference—Atlanta, Oct. 8-10. W. A. Nelson, Charlottesville, Va.

American Welding Society—Philadelphia, Oct. 8-13. M. M. Kelly, 33 West 39th St., New York.

Eastern Association of Electrical Inspectors—Municipal Bldg., Springfield, Mass., Oct. 10-11. R. Walker, 85 John St., New York.

Kansas Section, N.E.L.A. — Wichita, Kan., Oct. 18-19. H. Lee Jones, 401 National Reserve Bldg., Topeka.

International Association of Municipal Electricians—Hotel Montelson, New Orleans, Oct. 22-26. H. N. Lang, Box 1864, Orlando, Fla.

Public Utilities Association of West Virginia—Hotel Pritchard, Huntington, Oct. 24-25. A Bliss McCrum, 514 Charleston National Bank Bldg., Charleston.

American Institute of Electrical Engineers — Regional meeting, Atlanta, Oct. 29-31. F. L. Hutchinson, 33 West 39th St., New York.

National Electrical Manufacturers' Association—Briarcliff Lodge, Briarcliff, N. Y., Oct. 29-Nov. 1. S. N. Clarkson, 420 Lexington Ave., New York.

National Electrical Wholesalers' Association—Chicago, Nov. 12-16. E. Donald Tolles, 165 Broadway, New York.

National Association of Railroad and Utilities Commissioners — New Orleans, Nov. 13-16. J. B. Walker, 270 Madison Ave., New York.

Public Utilities Association of Virginia—Hotel Roanoke, Roanoke, Va., Nov. 21-22. A. B. Tunis, 301 East Grace St., Richmond, Va.

DAYTON'S NEW 25,000-KW. TURBO-GENERATOR. — With the installation of generating unit No. 6 in the Miller's Ford plant of the Dayton (Ohio) Power & Light Company, the capacity of that plant has increased to 110,000 kw. The new unit is rated at 25,000 kw. and is thus larger than Nos. 1 and 2, installed in 1918, with a rating of 12,500 kw. each, and Nos. 3, 4 and 5, subsequent additions, rated at 20,000 kw. each. The station has now reached its ultimate size and provides a margin of 35,000 kw. in excess of the immediate local demand. Coincidentally with the completion of unit No. 6 the company shut down its Fourth Street steam plant.

CONSTITUTIONALITY OF NEBRASKA HYDRO-ELECTRIC LAW CONTESTED.—E. M. Searle, Jr., has appealed to the Nebraska Supreme Court from a decision of the District Court at Scottsbluff denying him an injunction to restrain the creation in and around the town of Gering of a hyrdo-electric district which has contracted to purchase energy from the municipal plant there. The law was passed at the last session of the Legislature and took the place of one found invalid by the Supreme Court. The unconstitutional measure permitted farmers to set up distribution system districts and issue bonds. Mr. Searle urges a number of reasons why the present law is unconstitutional, insisting especially that the law limits the right of voting on the organization of a district to resident property owners only.

ELECTRIC CLUB OF PHILADELPHIA ORGANIZING EXHIBITION.—Signalizing the transition of the Electric Club of Philadelphia to a metropolitan business-development league, equipped to carry on continuous promotional activities, Alfred L. Hallstrom, chairman of the development committee, announces, on behalf of the club's board of governors, that the first step will be the staging of an electric and radio exhibition in the Coliseum, the city's largest auditorium, to last from Nov. 17 to Nov. 24. There will be 361 booths, and an attendance of 200,000 persons is looked for. The show will cover the entire gamut of electrical display, including spectacular lighting features, every possible educational phase of electrical phenomena and home use of electrical appliances. The general chairman will be E. E. Hedler.

FINAL BRIEFS IN SAN FRANCISCO FIGHT FILED WITH COMMISSION.—Final briefs in the valuation and condemnation proceedings of the city of San Francisco against the properties of the Pacific Gas & Electric Company and the Great Western Power Company that it proposes to use for distribution of electrical energy from the Hetch Hetchy system were filed early this month. It will be remembered that San Francisco believes that $18,894,005 is an equitable valuation for the properties of the Pacfic Gas & Electric Company which it will require, while that company, on

the other hand, is of the opinion that it should receive $67,000,000. The municipality has set a value of $9,306,537 on the properties of the Great Western Power Company it proposes to use, though the Great Western believes it is entitled to $30,000,000. The commission will now proceed with its adjudication, with much likelihood of the case reaching the courts. The valuation proceedings have cost the taxpayers of San Francisco more than $300,000.

LOS ANGELES ADDS 82 STREET-LIGHTING SYSTEMS IN YEAR.—In the fiscal year which closed June 30 82 new and separate street-lighting systems were placed on Los Angeles city streets. These installations necessitated the erection of 112 miles of posts. There are now more than 550 miles of standards, containing 28,834 units. Of these, 12,366 support one lamp, 14,717 two lamps, 63 three lamps, and 1,625 hold five and 62 six lamps. This system represents an approximate investment of $11,750,000. The average annual cost of the new mileage erected in the past six years has been $1,500,000. Prior to that time the annual average had been but $500,000.

RIVIÈRE DES PRAIRIES PLANT, NEAR MONTREAL, WILL YIELD 90,000 HP. CONTINUOUSLY.—The great size of the power project being undertaken by the Montreal Light, Heat & Power Consolidated on the Rivière des Prairies, north of Montreal, is revealed in facts presented by the company recently. There is to be developed a continual supply of 90,000 hp. The dam, which is at present under construction, will ultimately have a length of 2½ miles. The power house will be 700 ft. long, 100 ft. wide and 75 ft. high and will contain ten turbines, each of which will be guarded by two intake gates. Most of the present work is being carried on where the river, formerly 16 ft. to 20 ft. deep, has been drained, and much of the more arduous labor is being carried on another 30 ft. below the river bed.

PLANS FOR REHABILITATION OF AUSTIN MUNICIPAL PLANT.—It is estimated by Walter E. Seaholm, superintendent of the municipal electric light and power plant of Austin, Tex., that approximately $1,000,000 will be required to put the plant in first-class condition. The city commission is considering the issuing of short-term water and light revenue bonds to finance the proposed improvements. Of the total amount to be expended, approximately $400,000 would be for the installation of a new generating unit and the remaining $600,000 to rehabilitate the existing distributing system. The bonds would be repaid over a period of ten years, at the rate of $100,000 a year. Approximately $150,000 of the annual revenues of the water and light department would be pledged toward the retirement of the debt, according to the plan under consideration.

HEARING ON STATE LINE GENERATING COMPANY'S PLANS.—At the recent hearing at Indianapolis before Harvey Harmon, a member of the Indiana Public Service Commission, of the petition of the State Line Generating Company of Hammond, Ind., for approval of its contracts for the sale of power to the Commonwealth Edison and other Insull companies (see ELECTRICAL WORLD of Aug. 25, pages 375 and 386), H. C. Heaton, the Chicago engineer who designed the State Line plant, estimated the cost of producing energy at about ¾ cent a kilowatt-hour if operated at more than 50 per cent capacity. The plans for a large generating plant at Michigan City (ELECTRICAL WORLD, May 12, page 934) were explained in the testimony. This plant will be operated by the Northern Indiana Public Service Company. Directors of the State Line company were given as follows: Britton I. Budd, Samuel Insull, Samuel Insull, Jr., Martin J. Insull and Edward Lloyd, all of Chicago; Ernest Van Arsdel, president of the Interstate Public Service Company of Indianapolis; C. W. Chase of Gary, M. O. Dell Plain of Hammond, Robert M. Fuestel and S. E. Mulholland, both of Fort Wayne, and L. B. Andrus, president of the Central Indiana Power Company of Indianapolis. Decision was reserved.

Commission Rulings

COMPANY'S RIGHT TO INSTALL CHECK METER ON STREET NEAR CUSTOMER'S PREMISES UPHELD.—The New Jersey Board of Public Utility Commissioners has dismissed a complaint against the Public Service Electric & Gas Company alleging excessive charges for electricity. The complainant objected to a check meter being placed on a pole near his home because of the company's belief that the meter in his residence was not registering properly. The commission said that an examination of the check meter showed that it was correct and that the company had the right to base its bill upon that meter's reading.

IRREGULARITY IN WIRING PASSED BY COMPANY'S INSPECTOR NO REASON FOR DISCONTINUANCE OF SERVICE.—Resumption of service discontinued because of the discovery of a lead connection on the wrong side of the customer's meter has been ordered by the Missouri Public Service Commission, this order being conditioned upon removal of the irregularity and the payment of approximate compensation for the energy diverted. The commission held that the customer was not responsible for the irregularity in the wiring. When he bought the house it was served by a Delco home generating plant and the lead connection was already made. He subsequently ordered central-station service, retaining the existing wires, and his installation was passed by the inspector of the complaining company, the Union Electric Light & Power. The commission held that the irregular wiring was too obvious not to have been installed in good faith.

Recent Court Decisions

MAINTENANCE OF TRANSFORMER AND CHOKE COIL ON POLE 20 FT. ABOVE GROUND NOT NEGLIGENCE AS REGARDS CLIMBING BOY.—Reddy vs. City of Watertown was a suit for damages because of the death of a boy who climbed a municipal electric light pole 20 ft., stood on a transformer and grasped a 2,200-volt choke coil in an attempt to balance himself. The Supreme Court of South Dakota sustained the trial court in holding that the accident was not one which the municipality could reasonably have been expected to anticipate and that therefore so far as regarded the trespassing boy no negligence had been shown. (220 N.W. 851.)*

IN JOINT SERVICE OF WATER AND LIGHT, ENERGY CANNOT BE REFUSED BECAUSE CUSTOMER VIOLATED RULES REGARDING WATER.—In Antisdel vs. Macatawa Resort Company, the Supreme Court of Michigan made two decisions. It held, first, that the company, which furnished service in the summer months, was authorized to require a patron to pay the cost of construction necessary to furnish "winter-circuit light," and, second, that the refusal of lighting service because the applicant would not comply with restrictions enforced in regard to water supply was unjustified, in the absence of any showing that waste of water had any relation to furnishing of light. (220 N.W. 768.)

MASTER DOES NOT BECOME EMPLOYEE'S GUARDIAN AS REGARDS RISKS INCIDENT TO CALLING.—The Court of Appeals of Kentucky has affirmed a judgment for the defendant in Green vs. Pennsylvania Railroad Company, in which damages were sought by a lineman who alleged that the company did not furnish him with a safe place to work and that the equipment supplied to him was defective in that a screw which his superior had connected came out of a turnbuckle, causing him to fall from the top of a pole. The court held that the lineman, who had not requested a safety belt, assumed the risk of injury and that his employer was not his guardian in the matter of ordinary risks incident to the work of a lineman. (8 S.W. [2d] 418.)

CITY'S CONSENT TO ERECTION OF POLE IN STREET DOES NOT ABSOLVE COMPANY FROM DAMAGES FOR PERSONAL INJURY CAUSED BY IT.—The Supreme Court of New Jersey has refused to reverse a finding for the plaintiffs in two suits brought respectively by Coan and Hilliard against the Public Service Electric & Gas Company and based on injuries received by the plaintiffs when they drove a car into a pole erected by the company in a Camden street with the permission of that city. The company held that, the pole being lawfully where it was, no liability for injury belonged to its owner and charged the injured men with contributory negligence. The Supreme Court found that the city's authorization did not absolve the company from responsibility for a pole erected so as to interfere with the safety and convenience of travelers and that whether there was contributory negligence was for the jury to decide. The injured men, it thought, had no reason to suspect the presence of the obstacle, so far as the evidence showed. (142 At. 665.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

H. C. Albrecht Named Operating Manager

H. Carl Albrecht, who became assistant operating manager of the Philadelphia Electric Company last spring, has been appointed operating manager in charge of production, transmission and distribution, laboratory and meter testing, stores, transportation and building management. Mr. Albrecht is well acquainted with the Philadelphia Electric system, having entered the employ of the company in 1909. During this period of almost twenty years he has engaged in design, construction and other phases of engineering work. Mr. Albrecht has also been appointed operating manager of the Philadelphia Suburban-Counties Gas & Electric Company. He is an active member of the National Electric Light Association and of the American Institute of Electrical Engineers.

GERARD SWOPE, president of the General Electric Company, sailed for Europe Sept. 14 aboard the White Star liner *Majestic* for a short sojourn abroad.

WILLIAM H. ONKEN, JR., editor of the ELECTRICAL WORLD, returned from Europe last week on board the *Leviathan*. While abroad he visited Belgium, France, Italy, Germany, Switzerland, Sweden and Great Britain. Mr. Onken was a representative of the American Institute of Electrical Engineers at the dedication of the Louvain Library and Engineers' Memorial in Belgium and attended the convention of the Union Internationale des Producteurs et Distributeurs d'Energie Electrique in Paris as a representative of the National Electric Light Association.

WALTER E. LONG, vice-president and controller of the Philadelphia Electric Company, has been elected vice-president in charge of accounting of the United Gas Improvement Company. Mr. Long is succeeding George W. Curran, resigned. Mr. Long entered the employ of the Philadelphia Electric Company as a bookkeeper in 1904. He has been active in the Accounting Section of the National Electric Light Association and has been prominently identified with the Pennsylvania Electric Association. Mr. Long has resigned his position with the Philadelphia Electric Company and has also retired as vice-president of the Philadelphia Suburban-Counties Gas & Electric Company.

JOHN R. HARTMAN, formerly industrial engineer of the Union Gas & Electric Company, Cincinnati, Ohio, has been appointed sales manager of the electric department of that company to succeed H. W. Derry, resigned. A graduate of the University of Cincinnati, Mr. Hartman was first employed by the Union Gas & Electric Company about five years ago as research engineer in the West End station. Subsequently he was transferred to the office of C. W. De Forest, vice-president, where he worked on special reports and aided in the selection of equipment for the new power plant at Columbia Park, Ohio. In February, 1926, Mr. Hartman was assigned to the industrial sales department as industrial engineer.

J. F. Ford Heads Accounting National Section

John F. Ford, assistant controller of the Philadelphia Electric Company, has been appointed chairman of the Accounting National Section of the National Electric Light Association by President

J. F. Ford

P. S. Arkwright. Mr. Ford is a graduate of the Drexel Institute in Philadelphia, where he specialized in accounting. He entered the employ of the Philadelphia Electric Company as a clerk in 1910 and in 1912 he was made supervisor of the tabulating section of the controller's department. Two years later Mr. Ford was promoted to be supervisor of the accounts payable auxiliary general ledgers. From the fall of 1917 until May, 1926, he was manager of the customers' accounts division, when he was appointed assistant controller.

Mr. Ford is a past-president of the Philadelphia Electric Company's section of the N.E.L.A. and he has served on important committees of the Pennsylvania Electric Association, as well as the National Electric Light Association.

JAMES T. ROOD has been appointed head of the department of electrical engineering at the University of Iowa, according to an announcement made by President Walter A. Jessup. For the past eight years the new appointee has been professor of electrical engineering at the University of Wisconsin. At Iowa he will succeed Prof. Arthur H. Ford, who has been given a leave of absence because of ill health. Before joining the Wisconsin faculty, Professor Rood taught at Ursinus College, Pennsylvania; the University of Alabama, Lafayette College and the University of Illinois. He is widely known as a consulting engineer and as a writer on original investigations.

PAUL C. SORSBY, for more than fifteen years associated with the General Electric Company in various capacities, both in this country and abroad, has opened offices in Augusta, Ga., to specialize in electrical testing and maintenance work.

JOHN W. KEENEY, superintendent of production of the Virginia Electric & Power Company, has resigned to accept a similar position with the Narragansett Electric Company at Providence, R. I. In leaving the Virginia utility Mr. Keeney takes with him a service record of 21 years, during which period he has advanced from the position of electrician to chief engineer of the Reeves power station in Norfolk and six years ago to the superintendency of production for the entire system.

HOWARD I. CAMPBELL, local superintendent for the Central Maine Power Company at Brunswick, has retired because of ill health. Mr. Campbell first became associated with the Central Maine organization in the spring of 1906. Starting as an assistant, Mr. Campbell gradually worked through the various positions in the company's employ and in 1918, when new duties were assigned to the superintendent, Mr. Campbell was appointed to the position. C. J. LAMB, formerly superintendent of the company at Lisbon Falls for eight years, has been selected to succeed Mr. Campbell as superintendent of the Brunswick division.

L. G. WAINMAN, assistant superintendent of distribution for the El Paso (Texas) Electric Company, has been appointed superintendent of distribution of the Ponce Electric Company, Ponce, P. R. Mr. Wainman has devoted his entire career to the public utility industry, having been connected with the Texas Power & Light Company during the period of its organization. He left that company in 1914 to join the Arizona Copper Company, but following the World War he returned to the light and power field, engaging in power plant construction work for the San Joaquin Light & Power Company. Later he was employed in the Department of Public Service, Los Angeles, being connected with the Bureau of Power and Light on substation work. Leaving California, Mr. Wainman entered the employ of the El Paso Electric Company, in the distribution department. In the spring of 1922 he was made electrical inspector and served as chief electrical inspector prior to becoming assistant superintendent of distribution.

G. W. Curran Resigns

George W. Curran has resigned as vice-president and secretary of the United Gas Improvement Company, Philadelphia. Mr. Curran's retirement from the dual office follows a connection with the United Gas Improvement and subsidiary companies which covers a period of 39 years. He will continue his association with the organization in a consulting capacity.

R. W. De Lancey has been elected vice-president of the Burke Electric Company, Erie, Pa.

George H. Winkler, formerly vice-president of the Burke Electric Company, Erie, Pa., has been elected president of that company to succeed James Burke, who has become chairman of the board of directors.

James Burke was elected chairman of the board of directors of the Burke Electric Company, Erie, Pa., at a meeting of the board held Sept. 10. Mr. Burke, formerly president, was elected to fill the office of chairman to succeed the late Isadore Hernsheim of New York, who had held that office from the organization of the company in 1906 until his death in August of this year.

Matthew S. Sloan, president of the Brooklyn Edison Company, the New York Edison Company and the United Electric Light & Power Company, was on Sept. 18 formally elected president also of the New York & Queens Electric Light & Power Company, in accordance with the officially indicated purpose of those in control of the four chief Greater New York light and power companies to combine their executive management under Mr. Sloan. This purpose was made clear two weeks or more ago, but the statement made in the Electrical World of Sept. 8 that the directors of the New York & Queens company had just made him president was premature.

Ford Kurtz has been appointed hydraulic engineer, in charge of the hydraulic division of the J. G. White Engineering Corporation, New York. Mr. Kurtz, who is a graduate of Cornell University, has been a member of the engineering staff of that company on both field and office assignments since 1910 and for the past six years has been in immediate charge of all hydraulic design work.

Herbert L. Ziegenbein, formerly connected with the Kalamazoo district of the Consumers Power Company, has been transferred to the Saginaw district as power engineer. Mr. Ziegenbein affiliated himself with the organization as combustion engineer at the Elm Street plant in Battle Creek in 1921 and the following year was transferred to the electrical engineering department. In October, 1922, he started power sales work under W. H. Sammis. For some time he was power engineer in the Jackson district and early in 1927 he was transferred to the Kalamazoo district.

Edward A. Brand, for the past eight years connected with the commercial department of the West Penn Electric Company in various capacities, resigned to affiliate himself with the New York Power & Light Corporation at Albany, N. Y. Mr. Brand will be engaged in commercial lighting, industrial lighting and architectural work under the supervision of Vice-President and Commercial Manager M. E. Skinner, formerly commercial manager with the Duquesne Light Company at Pittsburgh.

Granger Named Regional Head of Company

Albert R. Granger, vice-president and general manager of the Delaware County Electric Company, has been appointed regional vice-president of the Philadelphia Suburban-Counties Gas & Electric Company, following the recent consolidation of the Philadelphia Electric Company, the Delaware County Electric Company and the Philadelphia Suburban-Counties Gas & Electric Company. The electric and gas operations in the Delaware division will be handled by Mr. Granger and Herbert C. Gross, who becomes manager of the Delaware County Electric Company. Mr. Granger is also vice-president of the Susquehanna Utilities Company, a subsidiary of the Philadelphia Electric Company.

A. R. Granger

Mr. Granger began his long career with the Philadelphia Electric Company as general utility man of the Edison Electric Light Company in 1892. Four years later he became a meterman for the Powelton Electric Company. After a short connection with the Wissahickon Electric Light Company, he was made superintendent of the Diamond Electric Light Company in 1900 and four years later he assumed the duties of general manager of the Beacon Light Company of Chester. He continued in that office until 1914, when he was appointed vice-president and general manager of the Delaware County Electric Company. Mr. Granger has by no means confined his attention to things electrical. He is Commissioner for Navigation for Delaware County, a vice-president of the Delaware County Chamber of Commerce and served as sheriff of Delaware County from 1917 to 1920.

Obituary

John Martin Hutton, engineer, for several years connected with power development projects, including the Schuylerville (N. Y.) dam and various power plants up-state, died in Syracuse, Sept. 4. For the past few years Mr. Hutton had been city engineer of Oneida. He was born at Bannock, Ohio, in 1875.

James T. Hessel, pioneer salesman in the electrical field, died Aug. 24 in a hospital in New York. More than 35 years ago Mr. Hessel began selling for a Philadelphia jobbing house. He was later associated with the Western Electric Company in New York, the Stuart-Howland Company of Boston, and in 1911 was one of the organizers of the Hessel & Hoppen Company of New Haven.

Frank N. Savage, superintendent of conduit construction of the street department of the Commonwealth Edison Company, Chicago, died Aug. 24, following an illness of about a year. A year after his graduation as an engineer from the University of Michigan Mr. Savage entered the company employ as draftsman in 1899. In 1900 he was made an inspector and five years later was named assistant civil engineer. He held the position of superintendent of conduit construction since 1911. Mr. Savage was 52 years of age.

George Sherman Hadley, secretary of Harvey Hubbell, Inc., Bridgeport, Conn., died Sept. 9 at his home in that city following a heart attack. Mr. Hadley was born in Long Hill, a Bridgeport suburb, 53 years ago. He was a nephew of the late Harvey Hubbell, who organized Harvey Hubbell, Inc., manufacturer of electrical equipment and specialties. Mr. Hadley became connected with the company as a boy of 17. Step by step he had advanced through the various positions until he was elected secretary of the organization several years ago.

William B. Wilkinson, district manager of the Ohio Power Company, Mount Vernon, died July 25, following an operation. At an early age he became interested in electricity, and in 1890 was named manager of the Mount Vernon Street Railway & Light Company, shortly after it was organized by P. B. Chase, now of Sparta, Ohio. When this company was sold by Mr. Chase in 1907, Mr. Wilkinson removed to Pittsburgh, where he assumed duties with the Westinghouse company. After a period of six years he transferred his interests to Newark, Ohio, as power sales manager for the Ohio Power Company. Later he was for a time in charge of the Mount Vernon property, but subsequently was transferred back to Newark, where he remained until 1925, when he was sent to Mount Vernon as district superintendent. Mr. Wilkinson was 64 years of age.

Financial and Statistical News

Marked Upward Movement Shown in July Operations

Rise of 10.6 per Cent in Energy Output—Revenue Gains 9 per Cent—Advances in All Parts of the Country

ACCELERATED growth in energy output and in revenue earned by electric light and power companies is revealed by reports covering all parts of the country, received by the ELECTRICAL WORLD in its monthly survey of the industry. In both respects the excess of the July figures over those of the corresponding month last year is greater than that for any other month since the early summer of 1927, with the single exception of the February energy, and that exception vanishes when the effect of the extra day in 1928 is taken into account.

The returns indicate a total revenue from electrical operation of $146,400,000, operating expenses of $64,900,000 and an energy output of 6,755,945,000 kw.-hr., of which 2,975,296,000 kw.-hr. was generated from water power and 3,780,649,000 kw.-hr. from fuels. The revenue was 9 per cent greater than last year and, as usual, breaks all records for the month in question. The increase in energy generated was even greater—10.6 per cent.

Although the revenue has run its usual course from the January peak to the July minimum, so that the final month's earnings were about 2 per cent below those of June, the gain over 1927 figures has been increasing each month since April, amounting successively to 6.0, 7.6 and 8.2 per cent and culminating in the still higher July ratio. The same may be said of the energy output, which exceeded that of last year by 6.2, 8.1 and 8.3 per cent in April, May and June respectively. The upward movement seems unmistakably to reflect a corresponding trend in industry as a whole.

Energy from water power continues remarkably high, constituting about 44 per cent of the total production and being almost 24 per cent greater than a year ago. Since the beginning of the year not a month has passed in which gain in hydro-electricity failed to overshoot the per cent gain in total energy.

Another unusual condition: the output from fuel has since April been only a trifle more than it was for the same time last year. The increase was about 1 per cent. Thus the new hydro plants and the abundant rainfall have, for a third of the year, taken care almost completely of the considerable increase in total output.

Fuel consumption correspondingly has on the whole not increased. Of coal the July consumption, not quite 2,878,000 tons, was 3.9 per cent lower than a year ago. But the use of natural gas is increasing and the consumption is now close to 7,000,000,000 cu.ft. a month.

Table I—Central-Station Financial Operations for the First Half Year in the United States
(100 Per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1928 Thousands	1927 Thousands	Per Cent Inc.	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands
April	$153,800	$145,100	+6.0	$85,500	$81,800	$51,900	$48,400	$5,100	$5,000	$11,300	$9,900	$64,100	$62,700
May	150,300	139,700	+7.6	83,400	77,600	51,100	46,800	4,950	4,650	10,850	10,650	65,700	63,100
June	149,500	138,700	+8.2	81,700	75,700	52,100	47,800	4,800	4,400	10,900	10,800	65,600	63,300
July	146,400	134,300	+9.0	78,500	72,100	52,300	47,250	4,580	4,320	11,020	10,630	64,900	63,400

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.

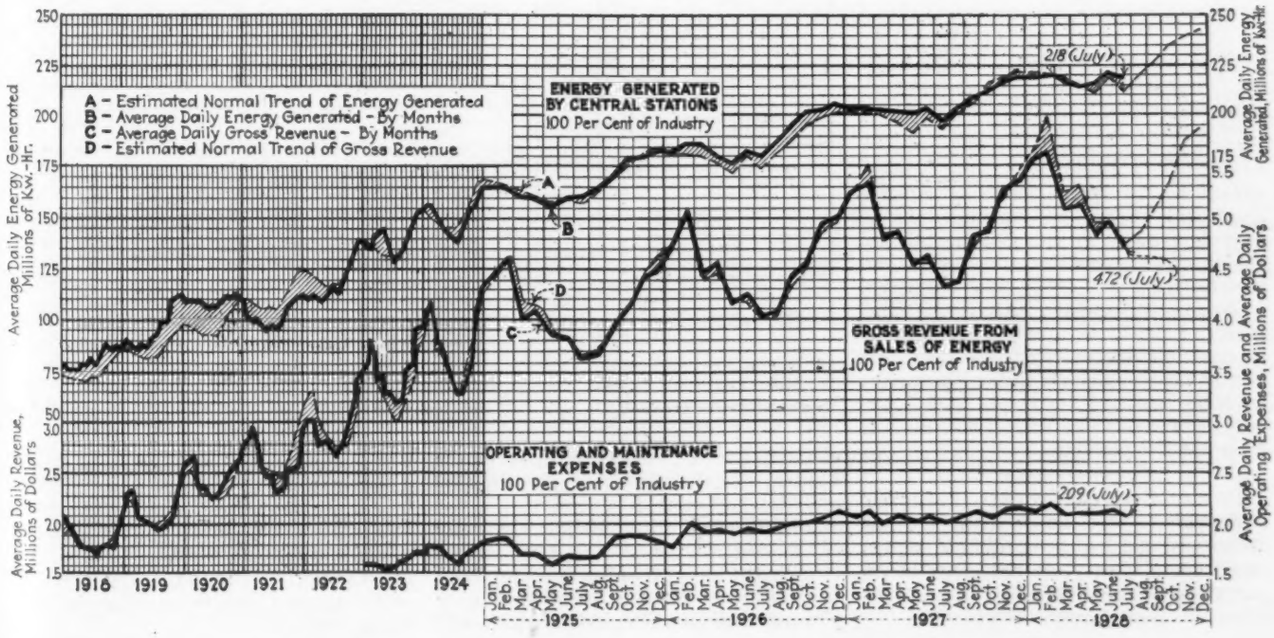

A – Estimated Normal Trend of Energy Generated
B – Average Daily Energy Generated – By Months
C – Average Daily Gross Revenue – By Months
D – Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALES OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
218 (July)
472 (July)
209 (July)
Average Daily Energy Generated, Millions of Kw.-Hr.
Average Daily Revenue, Millions of Dollars
Average Daily Revenue and Average Daily Operating Expenses, Millions of Dollars
1918 1919 1920 1921 1922 1923 1924
1925 1926 1927 1928

Table II—Generation and Distribution of Central-Station Energy in the United States

(100 Per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly *			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1928 †Thousands	1927 Thousands	Per Cent Inc.	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands
April..	6,424,853	6,049,656	+ 6.2	5,287,853	4,979,656	1,323,000	1,235,000	3,464,853	3,194,656	500,000	472,000	1,137,000	1,070,000	1,184,000	1,189,000
May..	6,721,597	6,218,471	+ 8.1	5,531,597	5,123,471	1,345,000	1,252,000	3,681,597	3,406,471	505,000	465,000	1,190,000	1,095,000	1,256,000	1,252,000
June..	6,637,121	6,127,247	+ 8.3	5,464,121	5,043,247	1,290,000	1,205,000	3,694,121	3,385,247	480,000	453,000	1,173,000	1,084,000	1,257,000	1,228,000
July..	6,755,945	6,109,472	+10.6	5,560,945	5,028,472	1,330,000	1,242,000	3,755,945	3,338,472	475,000	448,000	1,195,000	1,081,000	1,265,000	1,178,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.
†1928 figures are only approximately comparable with those for 1927, because of changes in classification of certain plants.

*Table III—Operations of Central-Station Hydro and Fuel Plants in the United States**

(100 Per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1928 Thousands of Kw.-Hr.	1927 Thousands of Kw.-Hr.	Per Cent Increase	1928 Thousands of Kw.-Hr.	1927 Thousands of Kw.-Hr.	Per Cent Increase	1928 Short Tons	1927 Short Tons	Per Cent Increase	1928 Barrels	1927 Barrels	Per Cent Increase	1928 Thousands of Cubic Feet	1927 Thousands of Cubic Feet	Per Cent Increase
April.....	2,831,446	2,526,938	+12.0	3,593,407	3,522,718	+ 2.0	2,806,131	2,942,421	—4.6	506,708	524,148	— 3.3	5,304,215	4,482,900	+18.3
May.....	3,071,603	2,625,427	+17.0	3,649,994	3,593,044	+ 1.6	2,821,472	2,918,935	—3.3	461,485	462,386	— 0.1	5,731,897	4,825,262	+18.8
June.....	3,010,054	2,491,840	+20.8	3,627,067	3,635,407	— 0.2	2,753,100	2,904,907	—5.2	478,042	453,025	+ 5.5	6,219,663	5,214,762	+19.2
July.....	2,975,296	2,401,852	+23.9	3,780,649	3,707,620	+ 1.9	2,877,987	2,996,291	—3.9	530,566	449,903	+18.0	6,592,073	5,598,713	+24.2

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

Sale of energy for resale has for the present become almost a constant quantity, ranging from 1,200,000,000 to 1,300,000,000 kw.-hr. a month. The reason seems to be, not that sales to other utilities for subsequent distribution have reached their limit, but rather that the increase is balanced by the effect of consolidations, whereby former intercompany sales become intracompany sales, though the energy may follow the same channels as before.

The uniformity in the progress made in different parts of the country is evident from the accompanying table.

The energy changes show a wider spread than revenue, but they indicate a general forward movement, with the largest growth in the South Atlantic region (34 per cent), in the West South Central (20 per cent), the Mountain (17 per cent) and the East North Central (13 per cent). All other regions showed an increase except the East South Central, which lost 14 per cent. In New England the output was 6 per cent above that in July, 1927, and in New York 9 per cent.

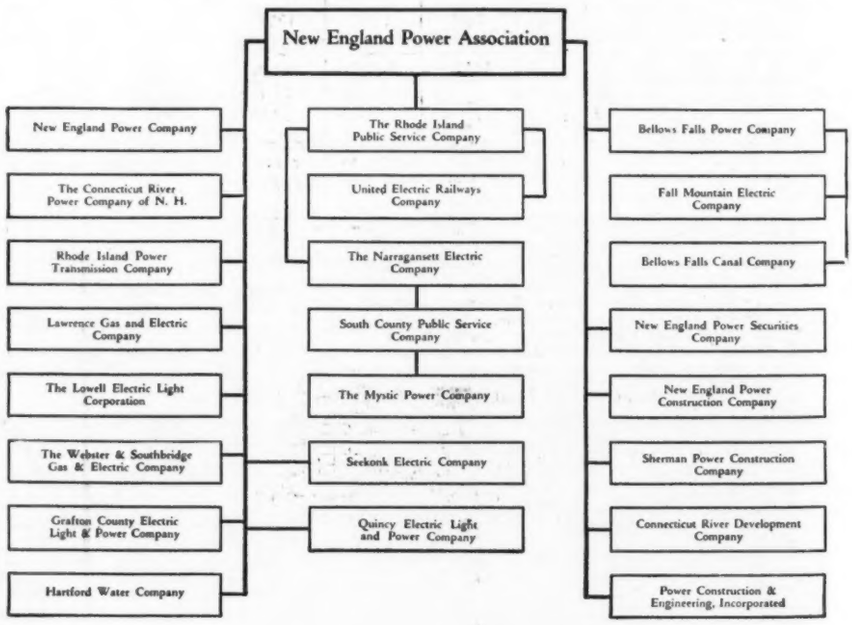
REGIONAL CHANGES IN REVENUE, JULY

Region	Per Cent Increase or Decrease Compared With July, 1927	June, 1928
New England	+ 6	—4
Atlantic	+ 9	—3
North Central	+ 8	—1
South Central	+ 8	0
Western	+12	+1

PUBLIC SERVICE SECURITIES LISTED.—The New York Stock Exchange has authorized the listing of 289,124 shares of $5 cumulative preferred stock of no par value of the Public Service Corporation of New Jersey.

Nineteen Years' Growth of New England Power Family Tree

On Sept. 1, 1928, the New England Power Association controlled 23 corporate organizations concerned in the financing, construction or operation of electric, gas or railway utilities in the Central Northeast. This organization and the non-related but interconnected Edison Electric Illuminating Company of Boston constitute the two largest electric utility organizations in New England from the standpoint of earning power. The New England association's largest central-station property is the Narragansett Electric Company, Providence, R. I., and its leading hydroelectric property is the New England Power Company, with affiliated transmission organizations in New Hampshire and Rhode Island. Recent important additions to the system include the properties at Lowell, Lawrence, Webster, Southbridge and Quincy, Mass. The organization has developed 225,000 hp. in hydro-electric plants since 1909, has in its own steam plants a capacity of 380,000 hp. and has begun to develop 250,000 hp. in additional water power on the upper Connecticut River in New Hampshire.


New England Power Association
New England Power Company
The Connecticut River Power Company of N. H.
Rhode Island Power Transmission Company
Lawrence Gas and Electric Company
The Lowell Electric Light Corporation
The Webster & Southbridge Gas & Electric Company
Grafton County Electric Light & Power Company
Hartford Water Company
The Rhode Island Public Service Company
United Electric Railways Company
The Narragansett Electric Company
South County Public Service Company
The Mystic Power Company
Seekonk Electric Company
Quincy Electric Light and Power Company
Bellows Falls Power Company
Fall Mountain Electric Company
Bellows Falls Canal Company
New England Power Securities Company
New England Power Construction Company
Sherman Power Construction Company
Connecticut River Development Company
Power Construction & Engineering, Incorporated

Detroit Edison Increases Capital

Stockholders of the Detroit Edison Company of record Oct. 15 have been given the right to subscribe at $100 par for additional stock of the company in the ratio of one share for each six shares of stock held, payable in full on Dec. 21 or in four equal installments on Dec. 21, 1928, and March 21, June 21 and Sept. 21, 1929. The last offering of stock was made in October, 1926. In a letter to stockholders President Alex Dow said:

"In August of 1927 we sold $20,000,000 of general and refunding bonds. This put us in funds for the construction work which went on through the winter and this summer, including increases in power plant equipment at Trenton Channel and Marysville and progress on the new power house at Delray—the building of which was announced to you in our report last year. There have been a number of important substations built and the usual extensions of lines, underground and overhead, to take care of greater output and the increased output which is still expected. During the last six months we have found it convenient to follow our practice during construction periods of borrowing, for the time, the money required for construction. The funds now to be raised by an issue of stock will pay off these borrowings, will reimburse the treasury and will leave a surplus for a continuation of the work in hand."

Middle West Utilities Declares Extra Dividend

Directors of the Middle West Utilities Company have declared a dividend of $2.25 a share on the outstanding $100 par preferred stock, payable Oct. 15 to holders of record Sept. 25, this sum being one-fourth of the regular annual dividend of 7 per cent plus 50 cents per share, thereby completing the payment of an additional dividend of 1 per cent required to be paid in any calendar year in which more than $6 per share is paid as dividends on the common stock.

Five New Issues Offered

First mortgage and first lien gold bonds of the Central States Power & Light Corporation were offered during the week ended Sept. 20 to the amount of $2,000,000 at 96 and accrued interest to yield about 5.80 per cent. Proceeds of this financing will be used to provide part of the funds with which to make payment for the properties lately acquired and for other corporate purposes.

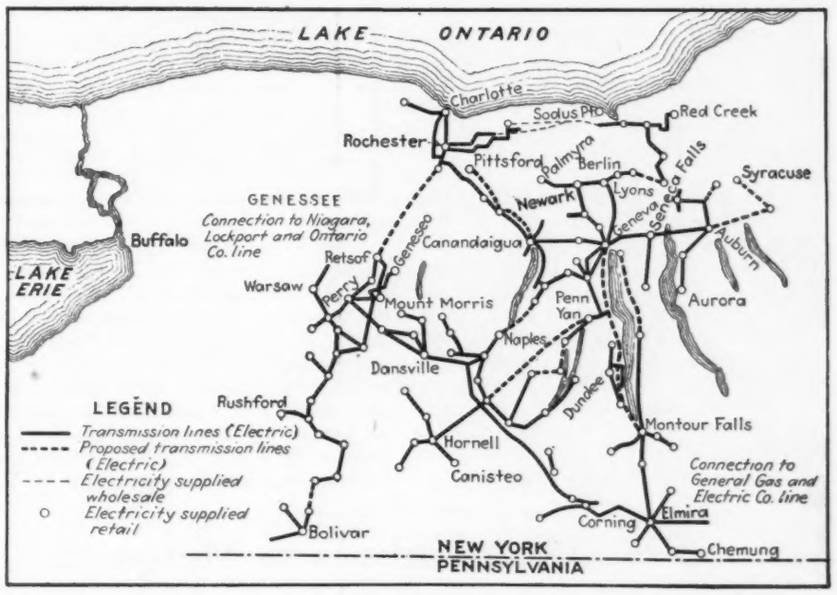
The Western Power, Light & Telephone Company made an offering of first lien collateral twenty-year 6 per cent gold bonds at 100 and interest, a piece of financing involving a total of $800,000.

Two new stock issues appeared among the week's new offerings. The People's Light & Power Corporation issued 10,000 shares of cumulative preferred stock, the price being $94 per share and accrued dividend, to yield 6.38 per cent. The Gulf Power Company issued 7,500 shares of six-dollar cumulative preferred stock at 96 and accrued dividends, to yield 6.25 per cent.

First and refunding mortgage gold bonds of the Carolina Power & Light Company were offered to the amount of $2,500,000 at 99½ and accrued interest. These securities, dated April 1, 1926, and maturing April 1, 1956, are secured by a first mortgage on the major portion of the property of the company. The proceeds from the sale of these bonds will be used to reimburse the company for expenditures made for additions to property and for other corporate purposes.

Rochester Central Power Corporation Completes Set-Up

ENTERING the market last week with an offering of twenty-two and a half million dollars of gold debentures, the Rochester Central Power Corporation, organized last June, raised funds with which to acquire the common stocks of a number of operating companies, including the Rochester Gas & Electric Corporation, the Empire Gas & Electric Company, the Elmira Water, Light & Railroad Company and the New York Central Electric Corporation. Proceeds from the sale of $18,000,000 of preferred stock and 1,600,000 shares of common stock will also be used for this purpose. The Rochester Central Power Corporation system will supply electricity and gas in thirteen counties in central New York State, a territory extending from almost 50 miles east of Buffalo to a point near Syracuse, and from Lake Ontario to the Pennsylvania border. Among the highly developed industrial and residential communities in the territory served are Rochester, Elmira, Auburn, Geneva, Hornell and Corning. The Rochester Gas & Electric Corporation, which furnishes the electric power and light and gas services in the cities of Rochester and Canandaigua and in numerous adjoining communities, and supplies steam for industrial and heating purposes to large industries adjacent to its Rochester steam plants, owns and operates hydro-electric plants having a present generating capacity of 46,530 kw. and steam plants with a generating capacity of 72,095 kw. The Empire Gas & Electric Company, which furnishes the electric power and light and gas services in Auburn, Geneva, Newark, Seneca Falls, Lyons, Palmyra, Phelps, Waterloo, Cayuga and Clifton Springs, and electric service in Weedsport, Clyde, Union Springs and Aurora, operates hydro-electric plants with a capacity of 10,600 kw. and steam plants with a capacity of 2,500 kw. The population served is estimated to exceed 85,000. The Elmira Water, Light & Railroad Company, which furnishes electric power and light, gas and street railway services in Elmira and electric power and light in Elmira Heights, Horseheads, Millport, Montour Falls, Odessa, Big Flats, Chemung and Southport, has steam-electric plant capacity of 27,750 kw. The population served is estimated to exceed 88,000. The New York Central Electric Corporation, which furnishes electric power and light services in Corning, Hornell



Transmission system of Rochester Central Power Corporation

REVENUE OF ROCHESTER CENTRAL POWER SYSTEM INCREASED DURING 1928

Twelve months ended May 31	1928	1927
Gross earnings	$20,333,930	$19,047,198
Operating expenses, maintenance and taxes	11,354,572	10,900,553
Net earnings	$8,979,358	$8,146,645
Interest and other deductions of subsidiaries	2,623,621	
Preferred dividends of subsidiaries	2,102,783	
Balance	$4,252,954	
Annual interest on 5% gold debentures (this issue)	1,125,000	

Dansville, Perry, Warsaw and 64 other communities, owns electric generating plants having a capacity of 5,200 kw. and purchases large additional quantities of electrical energy upon very favorable terms.

Several properties of the Rochester Central Power System are interconnected with the lines of the Niagara, Lockport & Ontario Power Company, thus affording the company access to the large hydro-electric generating stations at Niagara. The system is also interconnected with the lines of the Syracuse Lighting Company and the Binghamton Light, Heat & Power Company.

Upon completion of present financing the capitalization of this new holding company will include 5 per cent gold debentures, series A, due 1953, outstanding to the amount of $22,500,000; 6 per cent cumulative preferred stock ($100 par value), $20,000,000 authorized, $18,000,000 outstanding, and common stock (no par value) authorized to the amount of 1,600,000 shares and outstanding to the same amount. The amount of these debentures authorized is limited by restrictions contained in the indenture.

The consolidated earnings of the Rochester Central Power Corporation and subsidiaries, after giving effect to the present financing, are given in the accompanying table. The operations and management of the corporation are under the direction of E. L. Phillips and associates, who have been responsible for the successful operation and development of the Long Island Lighting Company and affiliated companies.

Reproduction Costs of Physical Properties

MANY investors, and particularly buyers of public utility bonds, are familiar with the terms "reproduction cost," as applied to the valuation of physical properties in recent years. Reproduction valuations have to a large extent taken the place of historical cost valuations. This has been due in part to the fact that recent decisions of the United States Supreme Court have recognized the cost to reproduce properties as a fair basis for rate structures, says a current news letter of Stone & Webster and Blodget.

There is still some difference of opinion as to the comparative merits of these two methods of valuation, but aside from this, it is interesting to note the relative results obtained at the present time by applying each of them in finding the value of properties.

For a twenty-year period previous to Jan. 1, 1916, the yearly average cost factor for light and power properties was about 90 per cent of 1914 figures. Subject to pronounced annual fluctuations, the average cost factor for the war period 1916 to 1920, inclusive, as well as for the post-war period 1921-1927, inclusive, was approximately 180 per cent of 1914.

Thus it is fairly obvious that the approach to equality between historical and reproduction cost for any given property or group of properties must depend to a great extent upon the proportion of existing property constructed during the pre-war years of lower prices and during the war period when prices covered a wide range.

While the relation between historical cost and reproduction cost, in order to be accurate, must be determined for each public utility property on its own merits, it is probably safe to say that in general historical cost is still materially less than reproduction cost and will continue to be less for some years to come. In one of the typical recent appraisals reproduction cost was found to be approximately 135 per cent of the historical cost of the light and power property examined.

Penn-Ohio Utilities to Merge

A PLAN to consolidate the Penn-Ohio Securities Corporation and the Northern Ohio Power Company with the Penn-Ohio Edison Company, controlled by the Allied Power & Light Corporation, has been announced as a means of simplifying the corporate structure of this public utility group. The announcement was contained in a joint letter to stockholders of the three companies, signed by R. P. Stevens as president of Penn-Ohio Edison and Penn-Ohio Securities and by B. C. Cobb as president of the Northern Ohio Power Company. At the present time the Penn-Ohio Securities controls the Penn-Ohio Edison, which in turn controls the Northern Ohio Power Company.

In the merger the Penn-Ohio Securities Corporation common-stock holders will receive one share of Penn-Ohio Edison common stock for each three shares of Securities common stock held. At present Penn-Ohio Securities owns a substantial block of the Edison common stock in the ratio of one share for each three shares of its own stock outstanding. The Penn-Ohio Edison Company already owns more than 95 per cent of the capital stock of the Northern Ohio Power Company, as a result of the exchange of stock in April and May this year. In the merger planned each share of Northern Ohio Power stock that is still outstanding is to receive two-thirds of a share of Penn-Ohio Edison common stock and one-third of an option warrant, series B, of the Penn-Ohio Edison Company.

The stockholders of the Penn-Ohio Edison Company are to receive subscription rights to purchase additional common shares at $35 a share, to the extent of 10 per cent of their holdings. The subscription to the additional stock has been underwritten, thus assuring the receipt of the proceeds, which will be applied toward the redemption on Nov. 1 of the $3,283,100 bonds of the Northern Ohio Power Company, Provision has also been made to permit the stockholders of the companies to be merged to participate in the subscription.

The holders of Northern Ohio Power capital stock have been offered an immediate opportunity to exchange their stock for Penn-Ohio Edison stock and warrants on the same basis offered in the merger plan, and holders who make this exchange at once will receive the subscription rights attaching to the Penn-Ohio Edison stock so received. The Penn-Ohio Securities Corporation will simply pass along to its stockholders, pro rata, the subscription rights to which the company will be entitled as a holder of Penn-Ohio Edison common stock. The holder of each thirty shares of Securities common stock will therefore be entitled to subscribe to one share of Edison common stock.

The combined assets of the merged companies and subsidiaries at the close of 1927 were in excess of $153,870,000. The principal subsidiaries of the group are the Northern Ohio Power & Light Company, the Pennsylvania-Ohio Power & Light Company, the Ohio River Edison Company, the Pennsylvania Power Company, the Pennsylvania-Ohio Public Service Corporation and the New Castle & Lowell Realty Company, most of which control subsidiaries of their own.

LOUISVILLE STOCKHOLDERS VOTE STOCK INCREASE.—Stockholders of the Louisville Gas & Electric Company of Kentucky at the recent annual meeting in Louisville authorized an increase in the total amount of preferred and common stocks from $45,000,000 to $90,000,000, of which $50,000,000 will be preferred stock. The authority given provides that the rates of dividend on preferred stock hereafter issued shall be fixed by the board of directors before issuance, but that in no event shall the rate exceed 8 per cent annually.

Business News and Market Conditions

Seventeen per Cent Rise in Construction Contracts

Middle Atlantic States Show 40 per Cent Increase — Elsewhere Growth Almost Uniform

BUILDING contracts were let in August at the rate of $73,500,000 worth per week, compared with $64,000,000 in July and $72,300,000 in August, 1927. The total for the five weeks of August is $367,563,000, compared with $256,115,000 for the four weeks of July. The increase is spread quite evenly throughout the country and all classes of construction participate, according to data compiled by *Engineering News-Record.*

The increase in total value of construction contracts awarded this year over that of the first eight months of 1927 is 17 per cent; this is the same percentage of increase that prevailed for the first seven months of the year over the corresponding seven months of 1927, and is accounted for principally by heavy lettings of streets and roads and buildings. Street and road lettings are $115,000,000, or 34 per cent heavier than last year. Industrial building awards are 16 per cent heavier and other building awards, exclusive of small residential work, are 15 per cent heavier. The value of unclassified contracts is 24 per cent under that of a year ago. Small declines are shown in water-works, sewers and excavations.

Except for a 40 per cent increase in the Middle Atlantic states, the geographical distribution of contract awards is quite even. The New England total is $166,000,000, compared with $163,000,000 in 1927. The South reports $179,000,000, compared with $151,000,000 a year ago. There has been a $100,000,000 gain in the Middle West and a $7,000,000 decrease in the region between the Mississippi River and the Rocky Mountains. The West Coast reports $224,000,000, compared with $248,000,000 in 1927.

What are the prospects for continued heavy contract letting in the next few months? Examination of the volume of new capital issued this year compared with last provokes some interesting thoughts but provides insufficient data upon which to base a prediction. As there appears to be a lag of four months between the issuance of new capital for construction and the award of contracts for this construction, the volume of new capital issued in April, May, June and July of 1927 will be compared with the value of contracts awarded in August, September, October and November of that year. This capital totals $1,716,000,000 for contracts which totaled $1,086,000,000, or 63 per cent of the value of capital. New capital issued in April, May, June and July of 1928 has totaled $1,999,000,000, and if the same proportion of this goes into engineering-construction contracts that went last year, the value of such contracts for August, September, October and November, 1928, will amount to $1,259,000,000. Of this hypothetical amount, $368,000,000 was awarded in August, leaving $891,000,000 to be awarded in September, October and November, compared with $797,000,000 actually awarded in those three months in 1927, if the 1927 proportion of contracts to capital issues is to be maintained.

This demands that value of contracts awarded in the next three months amount to 12 per cent more than in the corresponding three months in 1927. In view of recent past performances, the attainment of such a bogey is by no means impossible. New capital issued in June, and still unused, was the largest amount on record. Set against this is the fact that issues in July were the lowest for that month since 1924 and amounted to only 44 per cent of the June total, whereas the July, 1927, figure amounted to 64 per cent of the June, 1927, total. Furthermore, August also is a seasonably low month and has always registered a decline from July. The volume of capital issued in the next few months, therefore, will bear close watching as an index of construction volume during the remainder of the year.

Bus Structure Office at Akron, Not Cleveland

The Middle western office of the Bus Structure Company, Springfield, Mass., recently announced as having been established at Cleveland, Ohio, should have been stated as at 380 Crosby Street, Akron, Ohio.

Production of Porcelain Electrical Supplies

The Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1928, the establishments engaged primarily in the manufacture of porcelain electrical supplies in 1927 reported, for that year, a total output valued at $22,871,610, of which amount $22,236,639 was contributed by porcelain electrical supplies (exclusive of the value of fittings) and $634,971 by miscellaneous products. Manufacturers of porcelain electrical supplies are canvassed annually for data in regard to production. The total production of porcelain electrical supplies (exclusive of fittings), including those manufactured as secondary products by establishments classified in other industries, for each of the three years 1925 to 1927, inclusive, was valued as follows: 1927, $22,565,848; 1926, $24,867,688; 1925, $21,826,971. The 1927 figure represents a decrease of 9.3 per cent compared with the value for 1926, but exceeds the figure for 1925 by 3.4 per cent.

Of the 54 establishments reporting for 1927, eighteen were located in Ohio, fifteen in New Jersey, seven in West Virginia, four in New York, two in California and one each in Connecticut, Illinois, Indiana, Maryland, Massachusetts, Michigan, Pennsylvania and Tennessee.

The statistics for 1927, 1926 and 1925 are summarized in the accompanying table. The figures for 1927 and 1925 were compiled from data collected at the regular biennial censuses of manufactures; those for 1926, from the returns made at the annual census of production. The 1927 figures are preliminary and subject to such correction as may be found necessary after further examination of the returns.

PRODUCTION OF PORCELAIN SUPPLIES INCREASED

	1927	1926	1925	Per Cent of Increase or Decrease (—) 1926–1927	Per Cent of Increase or Decrease (—) 1925–1927
Number of establishments	54	50	49	[1]	[1]
Wage earners (average number)	6,808	[2]	6,462	.....	5.4
Wages[4]	$7,897,279	[2]	$7,947,795	.....	—0.6
Cost of materials, shop supplies, fuel, and purchased power[4]	$7,655,967	[2]	$6,361,812	.....	20.
Materials and supplies	$6,210,857	[2]	[5]	.....	.....
Fuel and power	$1,445,110	[2]	[5]	.....	.....
Products, total value[4]	$22,871,610	$25,499,087	$21,370,126	—10.3	7.0
Porcelain electrical supplies (exclusive of fittings)	[6] $22,236,639	[6] $24,689,747	[6] $20,986,297	— 9.9	6.0
All other products	$634,971	$809,340	$383,829	—21.5	65.4
Value added by manufacture[7]	$15,215,643	[3]	$15,008,314	.....	1.4
Horsepower	15,334	[3]	12,073	.....	27.0

[1] The per cent is not computed where base is less than 100.
[2] Not including salaried employees.
[3] No data.
[4] The amount of manufacturers' profits cannot be calculated from the census figures for the reason that no data are collected in regard to a number of items of expense, such as interest on investment, rent, depreciation, taxes, insurance, and advertising.
[5] Not separately reported.
[6] In addition, porcelain electrical supplies were made to some extent as secondary products by establishments classified in other industries, as follows: For 1927, $329,209; for 1926, $177,941; and for 1925, $840,674. The total production by all establishments was valued as follows: 1927, $22,565,848; 1926, $24,867,688; 1925, $21,826,971.
[7] Value of products less cost of materials, mill supplies, containers for sale with products, fuel, and purchased power.

Analysis of N.E.M.A. Services

Functions of association are charted by classes of manufacturing and by departments in which service is rendered to the electrical manufacturing industry and related groups

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Classes of Manufacturing

Generation and Conversion			Control and Measurement			Conductors			Transmission and Distribution									Communication			Utilization											
																					Power				Heat			Light				
Generators	Rotary Converters	Rectifiers	Instruments	Meters	Industrial Control	Porcelain Insulation	Other Insulation	Wire and Cable	Carbon	Resistance Alloys	1. Primary	Power Switchgear	Transformers	Line Material	Insulators	2. Secondary	Panelboard	Distribution Board	Switches	Circuit Breakers	Conduit and Raceways	Wiring Devices	Radio	Signaling Apparatus	Traffic Lighting	Industrial	Transportation	Commercial Appliances	Domestic Appliances	Furnaces and Ovens	Welding	Cooking	Domestic Appliances	Therapeutic	Incandescent Lights	Arc Lights	Other Lights	Street Lighting Units	Commercial Units	Other Units

			Publications and File References	File No.
Services Relating to	Policy and Management	NEMA Membership	Function and Purpose of NEMA—Constitution and By-Laws—Manual of Organization	101
		Labor	Labor Committee of NEMA—The Labor Committee and Its Work	102
		Conciliation	NEMA Conciliation Committee	103
		Contacts with: Congress	Law and Legislative Committee	104
		Contacts with: Government Depts.	Actions taken regarding national legislation	105
		Contacts with: State and Local Depts.	Method of cooperation in regard to state and local legislation	106
		Contacts with: Underwriters	Underwriters' Laboratories Committee	107
		Contacts with: Other Bodies	N. E. L. A.—A. I. E. E.—A. E. S. C.—S. E. D.—A. E. I.—etc. Industry Relations Committee—Manual of Organization	108
		Uniform Statute	Need for Uniform Ordinance—Uniform Electrical Ordinance—Uniform Statute	109
		Legal Review	NEMA retains counsel who reviews all minutes of the Association	110
		Cost Accounting	Standard Accounting and Cost System for the Electrical Manufacturing Industry	111
		Tariff	Tariff Committee and its work	112
		Code of Ethics	NEMA Code of Ethics—Business Policies Committee and its work	113
	Engineering	Technical Standardization	The NEMA Standards Committee	201
		American Standards	The A. E. S. C. and How It Operates	202
		N. E. Code Development	The Casualty and Fire Prevention Committee—The National Electrical Code (Purpose and Development)	203
		Safety Code Development	National Electrical Safety Code	204
		Simplification	NEMA policy with Department of Commerce on simplification projects—Bureau of Standards	205
		Published Standards	Published Standards on Radio—Supply—Apparatus—Appliances	206
		Instruction Books	Care and Installation of Transformers	207
		Other Organizations	Industry Relations Committee—Cooperates with outside bodies in matters of mutual interest	208
	Manufacturing	Factory Management	(Facilities available through the action of related committees such as Conciliation Committee, Labor	301
		Personnel Problems	Committee, Business Policies Committee, to give matters of this kind consideration by qualified	302
		Safety of Workmen	groups or individuals)	303
	Sales	Statistics: Orders Entered	Twenty product groups reporting statistics on annual, semi-annual, quarterly and monthly	401
		Statistics: Shipments	basis, covering 20 lines and 140 items. The figures include orders, shipments, stocks,	402
		Statistics: Stocks	etc. NEMA Statistical Department	403
		Statistics: Miscellaneous	The Radio Market (dealer and wholesaler stocks)	404
		Statistics: Closed Transactions	Statistics on closed transactions	405
		Market Development: Industry Sales Conf.	Electrical Industry Sales Conference—Cooperative Market Development—Relations with S. E. D.	406
		Market Development: Producers Council	The Producers Council and How It Operates	407
		Market Development: Rural Electrification	Committee on Relation of Electricity to Agriculture	408
		Market Development: Market Analysis	Market analysis studies in cooperation with interested bodies	409
		Market Development: Shows and Exhibits	NEMA Policies on Shows and Exhibits	410
	General	Staff	Trained staff includes managerial, statistical, publicity and engineering personnel	501
		Publicity, Publications	Service includes newspaper and business press releases, NEMA News, Standards notes, etc.	502
		Information	Information service on a wide variety of topics relating to electrical manufacturing	503
		Meeting Facilities	Meeting rooms at headquarters available by arrangement with office manager	504
		Miscellaneous	Meetings arranged, reservations, employment service, secretarial, etc.	505

Market Conditions

THE Pacific Coast area seems to take the lead this week in the total of new orders for electrical equipment, and very substantial business is in sight for the early fall. Provision of lighting standards for Oakland involves bids, the lowest of which is $167,500. Prices for the most part are distinctly firmer. In the Middle West and in the St. Louis area also business is decidedly active, with utility companies putting forth every effort to complete major construction before the cold weather.

Along the Atlantic seaboard business as a whole is very satisfactory and in some areas is increasing rapidly. In New England line supplies are a feature, touching a high level for the year in some sections. Central-station business, especially in transformers and outdoor substation equipment, is exceedingly good in the Eastern district. In the Southeast small-sized orders have accumulated and there are some large orders, such as one originating in the New Orleans district for a 15,000-kw. turbine and auxiliary equipment totaling $300,000.

Central-Station Business Active in Eastern District

Central-station business continues to show improvement in the Eastern district, and incoming inquiries are developing in an encouraging manner. A central-station company in northern New York has placed an order for transformers and outdoor substation equipment to cost $45,000. A Greater New York utility company has given a commitment for transformers and switchboard panels, with accessories, to an amount of $25,000. A New York traction line has contracted for a quantity of turbine parts for miscellaneous repairs to prime movers.

Business with railroads shows little change in immediate account. Present commitments are for apparatus for maintenance and repair service. Marine equipment is developing to satisfactory proportions, and both present and immediate future transactions indicate a sizable amount of business. There is keen interest among local manufacturers for equipment contracts to be let by New York State for two Diesel electric ferryboats for service at Ward's Island and for which bids have just been asked.

Industrial demand continues on a good basis. There is an increased volume of small orders and a reduced call for heavy apparatus. A manufacturer of industrial motors reports business as fair. The bulk of current demand is from chemical plants, iron and steel mills and automobile manufacturers. A New York maker has secured a contract for motors for a peanut-butter factory in Oklahoma, while another local manufacturer has received a commitment for motors, controls and other electrical equipment for a feldspar milling plant in North Carolina. There is a fair call for motors from oil-burner and refrigerator manufacturers. Fractional units are also recording encouraging business.

There is a growing demand for floodlighting equipment for airport service, and an Eastern producer has secured contracts from Virginia, Texas and other points. Electric signal equipment is developing a stronger tone. A maker of such apparatus at New York has obtained a contract from an interest in the northern part of the state to an amount of $40,000. A fuse manufacturer reports trade as slow both from jobbing and industrial consumers, and plug fuses are receiving better attention than those of the cartridge type. Business for vacuum cleaners is on the upward trend and electric refrigerators are in good demand. Construction operations in the Eastern district include the following:

The Union Carbide & Carbon Corporation, New York, plans a metallurgical plant in the vicinity of Boncar, Va., to cost $3,000,000, and the New-Kanawha Power Company, a subsidiary organization, plans a hydro-electric plant at Hawk's Nest on the New River, in the same vicinity, to cost $7,500,000. William A. Vecchio, Mount Vernon, N. Y., and associates plan an ice-manufacturing plant to cost $250,000. Buffalo plans a vocational school to cost $1,000,000. Montgomery, Ward & Company, Chicago, plan a mail order storage and distributing plant at Albany, N. Y., to cost $650,000. Lewis Newhoff & Son, Albany, N. Y., plan an addition to cost $100,000. The American Neon Light Corporation, New York, plans a plant and expansion program to cost $1,000,000. The First Avenue Association, New York, plans additional street-lighting units. The Public Service Electric & Gas Company, Newark, N. J., has secured permission for an equipment storage and distributing plant at Jersey City, to cost $250,000. Princeton, N. J., will install additional street lamps.

The Hobson Flatware Company, Lansdale, Pa., plans a plant at Lambertville, N. J., to cost $80,000. The Hudson Coal Company, Scranton, Pa., will make extensions in its coal breaker near Carbondale, Pa., to cost $150,000. The West Penn Power Company, Pittsburgh, plans extensions in transmission lines in the vicinity of Dunbar, Pa. New Castle, Del., plans improvements in its lighting system. The Consolidated Gas, Electric Light & Power Company, Baltimore, plans extensions in the plant of the Terminal Heating & Freezing Company, recently acquired, to cost $500,000. The Bureau of Supplies and Accounts, Navy Department, Washington, will receive bids until Oct. 2, for power transformers, safety switches and switchboard panels for the Pearl Harbor (T.H.) navy yard (Schedule 9703). The Bureau of Yards and Docks, Navy Department, Washington, will receive bids until Oct. 10 for two 250-kw. Diesel engine generators, with starting equipment and exciter, motor-generator set, switchboard and accessory apparatus for the Guantanamo Bay (Cuba) naval station (Specification 5699.)

Prices of Copper, Lead and Tin Advance

In the most broadly active metal market of recent years copper has advanced to 15 cents per pound for Eastern deliveries, lead has gone up ten points to 6½ cents, New York, and tin has advanced ¼ cent over the quotation of a week ago. On the other hand, zinc remained quiet and unchanged and silver declined slightly. The activity in the metal market follows renewed assurances of industrial activity in the fall and early winter, though without doubt there has been some speculative demand for forward positions, brought about by a feeling among consumers that prices were likely to advance.

NEW YORK METAL MARKET PRICES

	Sept. 12, 1928 Cents per Pound	Sept. 19, 1923 Cents per Pound
Copper, electrolytic	14.75	15.00
Lead, Am. S. & R. price	6.40	6.50
Antimony	10.75	10.625
Nickel, ingot	35	35
Zinc, spot	6.60	6.60
Tin, Straits	47.50	48.00
Aluminum, 99 per cent	24.30	24.30

Base copper wire price Sept. 19, 1928, 16¼ cents.

Good Volume of Small Orders Reported in Southeast

A well-sustained volume of small-sized orders and a slight increase in the number of moderate-sized orders are to be noted in the Southeast. The largest order placed was from the New Orleans district for a 15,000-kw. turbine and auxiliary equipment totaling $300,000. A power company in Tennessee ordered power-plant equipment which will cost between $200,000 and $300,000, while a power company in the Carolinas ordered power-house motor auxiliary equipment amounting to $50,000. A coal mine in Tennessee purchased a 500-kw. turbine and motor-generator set amounting to $60,000. A central station in Alabama placed an order for insulated cable amounting to $30,000, while an order for this same material totaling $25,000 was received from Jacksonville. A Georgia company ordered cross-arms totaling $3,500. Merchandising activities of central stations are reflected in the good business distributors and jobbers report for this class of material, one of the leading Georgia jobbers stating that his appliance business is more than 20 per cent ahead of this period of last year. A contractor in middle Georgia ordered lighting fixtures in excess of $1,000 for a college building under construction. Construction projects are as follows:

The Mengel Body Company, Louisville, Ky., plans an addition to its automobile-body plant to cost $800,000. The Briggs Manufacturing Company, Detroit, plans an automobile-body plant at Knoxville, Tenn., to cost $200,000. The Mead Fibre Company, Kingsport, Tenn., plans an addition to cost $75,000. The Hartsville Print & Dye Works, Hartsville, S. C., will build an addition to cost $90,000. Mobile, Ala.,

plans an ornamental lighting system to cost $200,000. The Archer Hosiery Mills, Columbus, Ga., plan an addition to cost $75,000. The Georgia Power & Light Company, Valdosta, Ga., plans power substations at Pearson and Cogdell, Ga. The Perry Paint & Glass Company, Tampa, Fla., plans a paint and varnish plant to cost $100,000.

New England Buying Line Equipment

An encouraging strength of sales in line supplies is noted throughout the New England district, with poles, wire and hardware moving in good volume. The recent shipments for service line extensions in Massachusetts and southern New Hampshire mark a high level for this year. Industrial equipment sales are steady and small-motor sales increased. The demand for 10-hp. motors and up gained owing to several orders from plants undergoing changes. Central-station supplies are attracting orders, and recently orders for house meters and watt-hour meters were placed amounting to $2,000. Insulators for substations are being placed steadily in small orders, and transformer sales are reported for several units, while orders for small switches and control equipment are strong. Orders for two special heat-treating electric furnaces were noted and electric automatically timed traffic signals are in strong favor. Negotiations are increasing, and orders for general supplies and equipment in good volume are pending. Construction projects are as follows:

The Saco-Lowell Shops, Boston, manufacturers of textile machinery, plan a plant at Biddeford, Me., to cost $85,000. The Nash Engineering Company, South Norwalk, Conn., plans an addition to its pump-manufacturing plant to cost $60,000.

Volume of Business Good in Middle West

The volume of business transacted in the Middle West is increasing, and indications are for a large fall business. Industrial activity is improving, the steel and automotive industries are prospering, and car loadings are large and diversified. Utility companies are busy, bending every effort toward the completion of a major portion of the outstanding construction before the fall season arrives. Interesting orders placed include one "Elesco" live-steam reheater complete with appurtenances, 6,000 5-amp. watt-hour meters, 250 Thompson meters of 5-amp. to 2,000-amp. capacity, 86 current transformers of 100-amp. to 1,000-amp. capacity and several construction orders valued at $75,000. Jobbers' sales are increasing. Construction plans are as follows:

The Wisconsin-Michigan Power Company, Appleton, Wis., plans extension in transmission line to Phelps, Wis. The Nash Motors Company, Milwaukee, plans an expansion program at its plant to cost $200,000. The Corduroy Tire Company, Grand Rapids, Mich., plans an addition to cost $70,000. The Houghton County Electric Light Company, Houghton, Mich., plans extensions in transmission lines in the Otter Lake district and improvements in the power plant at Houghton. The Reo Motor Car Company, Lansing, Mich., plans an addition to cost $400,000. Baker-Perkins Company, Saginaw, Mich., manufacturer of chemical machinery, etc., plans an addition to cost $100,000. The Evans-Wollower Company, Joplin, Mo., will build an electrolytic zinc plant in East St. Louis, Ill., near the Cahokia power plant, to cost $1,250,000. The B. F. Goodrich Company, Akron, Ohio, will build an addition to its rubber mill to cost $1,000,000. The Union Light, Heat & Power Company, Cincinnati, plans an equipment storage and distributing plant with mechanical repair department, to cost $200,000. The Gardner-Harvey Container Company, Middletown, Ohio, plans a paper box and container mill to cost $300,000. The Niles Steel Products Company, Niles, Ohio, plans an addition to cost $140,000. Urbana, Ohio, plans a municipal electric light and power plant to cost $470,000. The Gage Electric Company, Beatrice, Neb., will build a transmission line in the vicinity of Rockford, Neb., and other points in Gage County. The Storecraft Manufacturing Company, Beatrice, Neb., will build an addition to its showcase-manufacturing plant, to cost $70,000. The Iowa-Nebraska Light & Power Company, Lincoln, Neb., plans an ornamental lighting system at Avoca, Iowa, to cost $30,000. The Greggson Company, Nebraska City, Neb., plans a dry rendering plant for fertilizer service, etc., to cost $90,000. The Jerpe Cold Storage Company, Omaha, Neb., plans an addition to cost $65,000.

Pacific Coast Leads in Volume of Contracts

The electrical contract for the new $3,000,000 Los Angeles General Hospital let for $72,000 is the largest order of its kind in a week on the Pacific Coast. Bids for 323 duplex lighting standards for downtown Oakland were taken under advisement, the lowest being $167,500. The city of San Francisco is in the market for about $10,000 worth of lead-sheathed signal cable for extensions to its underground traffic signaling system; the city of Bakersfield needs about $2,500 worth of No. 8 leaded-cambric cable for a street-lighting extension, and a Honolulu inquiry covers one carload of clay duct. Other street-lighting prospects concern San Carlos and Santa Cruz, the latter being estimated at $45,000. It is rumored that Eastern hotel interests intend to purchase the Devonshire tract in the Bay Peninsula district for an outstanding country club resort. Other big projects cover a $2,000,000 insulating board plant in St. Helena, Ore., and a can factory in Pittsburg, Calif. With the exception of condulets, which have decreased to an average of 7½ per cent for the entire line, and rigid iron conduit, which has dropped 5 per cent, prices are distinctly firmer and general contracting business is improved. Retail business has picked up and an excellent though rather late holiday season is expected. The outstanding machinery order covers a 15,000-kva. Westinghouse synchronous condenser and regulating equipment, valued at $70,000, for the Midland Counties Power Company and for installation at Santa Maria.

Sales made by Seattle jobbers included large numbers of single-phase motors for apple-wiping machines to dealers in the orchard districts in eastern Washington. Buying from lumber mills was light, although there were numerous inquiries reported. The town of Edmonds, near Seattle, is taking bids for three motor-driven deep-well pumps, costing $800 each, and the town of Wapato, in Yakima County, is taking bids for a deep-water turbine pump, costing about $1,500. The sale of fifteen motors from 200 hp. down for a cement mill in Spokane was reported. An ordinance providing for the Diablo Canyon power plant of the city of Seattle, involving a power house, two generating units of 40,000 hp. each, penstocks, surge tanks, gates, valves, a transmission line from Diablo to Gorge Creek, etc., costing $2,900,000, is being drafted by the City Council. The city of Tacoma is taking bids for additional transformers, including one of 1,650 kva. and two of 600 kva.; also for four 600-amp., 15,000-volt outdoor-type oil circuit breakers. A small hydro-electric plant at Nespelem is planned by the Indian irrigation service. Construction projects are as follows:

The Marin County Milk Company, San Rafael, Calif., plans a creamery plant to cost $125,000. The Pacific Gas & Electric Company, San Francisco, has applied for permission for a hydro-electric development on the Mokelumne River, Amador County, to cost $6,000,000. Tacoma, Wash., plans a power substation to cost $35,000. The Barde Steel Company, Tacoma, plans an addition to cost $200,000. The American Refrigerator Transit Company, Pueblo, Colo., plans extensions in its car repair shops to cost $85,000. Los Angeles plans an ornamental lighting system.

Improvement Noted in St. Louis District

There has been an improvement in the general tone of electrical business in the St. Louis district. The volume of sales of the smaller sizes of apparatus has come back to normal. One order amounting to $15,000 for miscellaneous pumping equipment was closed. An order was placed for a switching locomotive to cost $27,000. Contracts have been let for construction materials in three large apartment hotels. Construction projects are as follows:

The West Texas Utilities Company, Abilene, Tex., will build a transmission line from Vernon to Holliday, Tex., with a power substation near the Wilbarger oil field and a transmission line to Dickens and vicinity with a substation. The Sleepy Water Company, Hot Springs, Ark., plans a power plant in the Sleepy Springs district, to cost $35,000. The Standard Potash Company, Dallas, Tex., plans a potash mining plant in Midland County, to cost $100,000. Fort Worth, Tex., has authorized a call for new bids for an ornamental lighting system. The Humble Oil & Refining Company, Houston, Tex., plans an expansion at its plant at Ingleside, near San Antonio, Tex., to cost $800,000. The Central Power & Light Company, San Antonio, Tex., will build a transmission line to Leakey, Tex., to cost $70,000. Stamford, Tex., will install ornamental lighting.

New Equipment Available

New Spring-Clamp Globe Holder

Distinct sales advantage is found in the new spring-clamp globe holder which replaces the old-style screw holder on all Benjamin "Glassteel" diffusers. The new spring-clamp arrangement is simple, consisting of only a cadmium-plated wire band gripping over 75 per cent of the globe neck and terminating in a tension clamp requiring only one motion to release. Time and effort required to remove and replace "Glassteel" diffuser globes have been reduced by this new holder—a single operation of the locking clamp and instant freedom of the globe being its features.

The chief advantage of the new holder is the ease and quickness with which a maintenance program may be carried out. Dust and dirt which gather on the globe and reflector cut down the effectiveness of the light source. The new holder allows instant removal and replacement, facilitates frequent cleaning and makes it convenient and easy to maintain the original efficiency.

Improved Single-Phase Motors

The General Electric Company announces an improved single-phase, repulsion induction motor. This motor, in sizes including ¾, 1, 1½ and 2 hp. at 1,800 r.p.m., supplements the company's present line of SCR motors. It is of the constant-speed, high-starting torque type for general application.

One of the most important improvements is the more efficient use of the stator punchings. This is accomplished by taking full advantage of the design possibilities of the polar winding of a repulsion motor. The most desirable distribution of stator coils in a repulsion motor is a sinusoidal distribution. This means, therefore, that the number of turns in the various coils of any one pole vary according to the angle from the pole center. Full advantage has been taken of this possibility by designing a four-pole motor using a square punching with graded slot depths, the slots being so arranged that the deep slots are placed at the corners where the maximum core is available and with the shallow slots placed in the flat portion of the punching where the minimum core is available.

As a result of this modification the active core section is unusually large, permitting a design of low flux density and larger bore. As a motor's output is a function of the square of the rotor diameter and the length, it is therefore possible to design a motor with small over-all length. Combined with this change in design a modification has been made in the commutator and brush rigging design so that the commutator end shield has the same dimensions as the pulley end shield.

The motor is inclosed except for ventilating openings in the lower portion of each end shield. Air is drawn through the ventilating openings at the pulley end by means of an internal fan, passes around the stator laminations and out through the ventilating openings in the commutator end. This construction makes a practically inclosed motor and provides complete protection against falling particles and splashing water. In spite of this and the small size of the motor, it is designed to operate within a temperature rise of 40 deg. C.

Regulating Rheostat

Neater appearance, low price and simplicity of installing are the features claimed for a new direct-current regulating rheostat made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The new rheostat can be used to control fractional-horsepower motors driving small blowers, fans, buffers, bookkeeping machines and similar apparatus and it can be used as a dimmer on lighting circuits or as an electric heater regulator. The device is of the circular plate type, completely inclosed. It may be mounted directly on machines or in any out-of-the-way place. The standard rheostat is furnished for conduit wiring, but can be used on open wiring by addition of a porcelain bushing.

Six-inch rheostat for fractional horsepower motors

The mechanism consists essentially of a cement-embedded resistance unit, with brass contact buttons protruding through the cement, and a contact arm which moves over the buttons, varying the resistance. An inclosing case with an outside operating lever protects the unit and prevents contact with live parts.

Line Material Company Has New Porcelain Cut-outs

The new EP45C6 fuse cut-out is announced by the Line Material Company, South Milwaukee, Wis. The new fuse is especially adapted to outdoor pole mounting for the protection of distribution transformers and circuits up to 4,500 volts. It is manufactured for fuse links rated 0.75 to 60 amp. The housing is of wet-process porcelain and is provided with lips over the lead entrances for protection from rain. The door is of bakelite and removable, insuring ease and safety in refusing. Two openings are provided on each side of the box for bringing in or taking out leads either at top or bottom. A special insulating fuse tube is provided with internal non-carbonizing lining, and brass end terminals are used. A galvanized cross-arm support is provided which can be adjusted to any size cross-arm.

Westinghouse Announces New Insulating Material

Through a process in which metallic magnesium is employed, the Westinghouse Electric & Manufacturing Company has perfected a new insulating material which the company's engineers claim represents a very definite step forward in electrical progress. The new material, it is stated, makes possible the production of electric heating devices with a higher efficiency and longer life than can be secured with the use of mica, asbestos and other standard insulating materials. In describing the properties of this new insulating material H. C. Bostwick, Westinghouse engineer, said:

The new insulating material, which is known as "Corox," is remarkable in having a higher insulating value at elevated temperatures and at the same time higher heat conductivity than mica, asbestos and other materials generally used to insulate electrical heaters. By virtue of these properties, it is now possible to improve the efficiency of electric heating apparatus by 10 per cent and increase its useful life 200 to 300 per cent. An unusual feature of "Corox" is that it is made from metallic magnesium, which conducts electricity.

The heating element, which is resistance wire of a high melting point, is wrapped round and round with metallic magnesium ribbon and the whole is then inserted in a tube or other shaped container. Steam at 450 lb. pressure is then forced through the tube or over the element and the magnesium metal then changes, first into its hydroxide and later to the oxide. The result is a tube containing a heater wire which is embedded in a hard, dense, white substance resembling marble. The ends of the tube are then sealed up, with electrical contacts projecting.

This process was invented by Christian B. Backer of Norway. The Westinghouse company purchased the American rights several years ago and research engineers have been engaged ever since with the problem of reducing the Backer principle to practice. This work has now been successfully completed and the new insulation is being regularly used in several of the company's products.